SOIL SURVEY OF

Tioga County, Pennsylvania

United States Department of Agriculture
Soil Conservation Service
in cooperation with
The Pennsylvania State University
College of Agriculture and the
Pennsylvania Department of Environmental Resources
State Conservation Commission

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1958–72. Soil names and descriptions were approved in 1973. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. This survey was made cooperatively by the Soil Conservation Service and The Pennsylvania State University, College of Agriculture, and the Pennsylvania Department of Environmental Resources, State Conservation Commission. It is part of the technical assistance furnished to the Tioga Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodland; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Tioga County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units and the woodland interpretations.

Foresters and others can refer to the section "Woodland," where the soils of the county are interpreted according to their suitability for trees.

Sportsmen and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings and for recreation areas in the section "Community Planning."

Engineers and builders can find, under "Engineering," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation, Morphology, and Classification of the Soils."

Newcomers in Tioga County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Environmental Factors Affecting Soil Use."

Cover: Pine Creek Valley in Tioga County, Pennsylvania. The soils of the Oquaga-Rock outcrop complex are on the valley sides. Oquaga soils are on the hilltops, and Pope soils are on the narrow flood plains.

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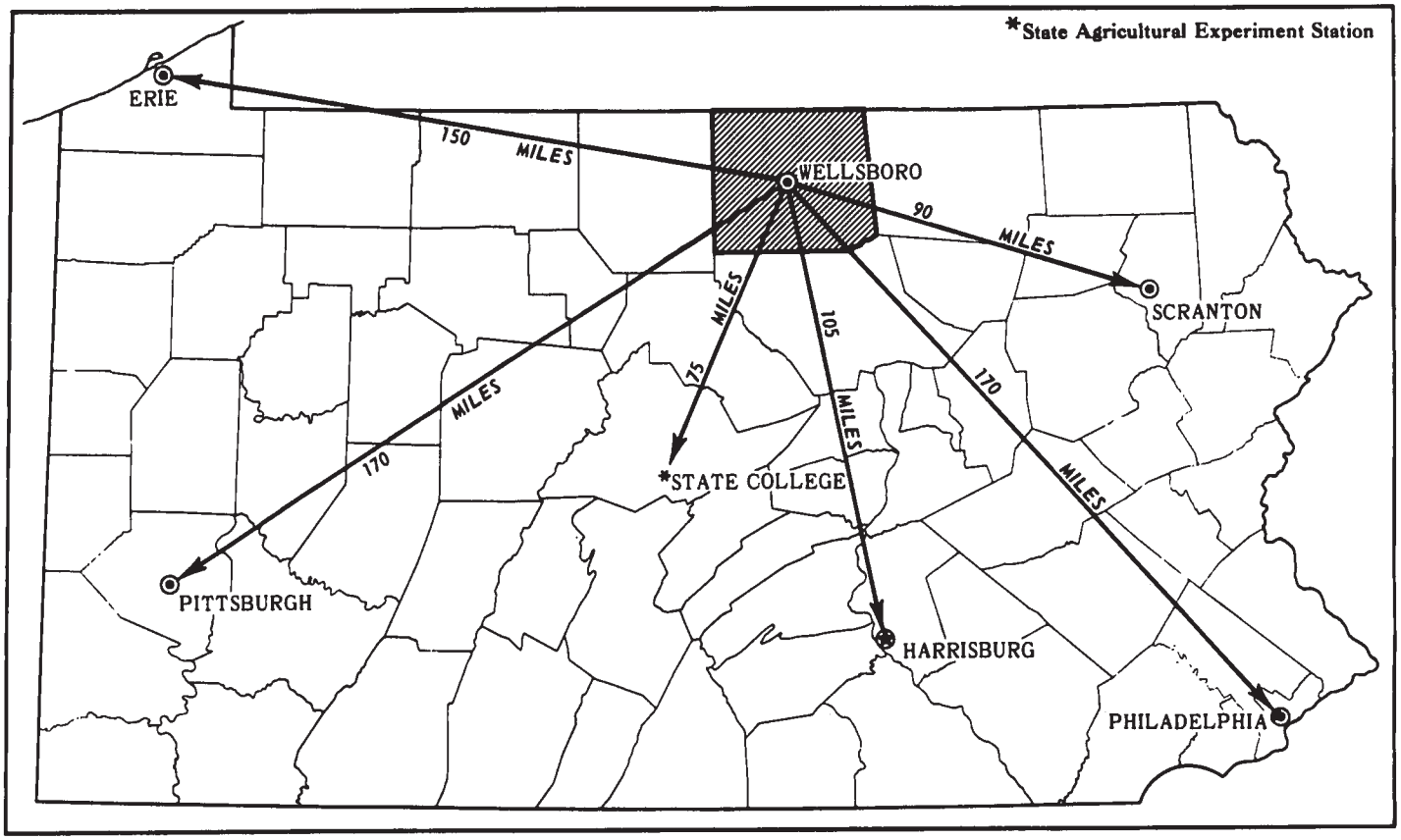

Location of Tioga County in Pennsylvania.

SOIL SURVEY OF TIOGA COUNTY, PENNSYLVANIA

BY JAMES B. RAYBURN AND WILLIAM L. BRAKER, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE PENNSYLVANIA STATE UNIVERSITY, COLLEGE OF AGRICULTURE AND THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES, STATE CONSERVATION COMMISSION

TIOGA COUNTY is in north-central Pennsylania and is bordered by New York State on the north. It is within easy driving distance of Baltimore, Pittsburgh, Buffalo, Syracuse, New York City, and Philadelphia.

Tioga County covers 1,146 square miles, or 733,440 acres. It was organized in 1804 from a part of Lycoming County. The population of the county was 39,000 in 1970. Wellsboro, the county seat, had a population of 3,940, and some 60 million people lived and worked within a radius of 200 miles.

The first settlers came into the territory in 1784 from New England. They first cleared land in the valleys for farming. Abundant supplies of timber and tanbark furnished the basis of two important early industries, tanning of hides and lumbering. Coal was discovered in the early 1800's, and mining was an important industry until 1930. Some coal is still being stripmined around Morris Run.

Farming was concentrated mostly along streams in the early days and gradually expanded to the sloping hills in the northern and eastern half of the county. In later years, however, many small farms were abandoned or sold for summer homes to people from other parts of the state or from New Jersey, Delaware, and Maryland.

Dairying is the main farm enterprise in the county. According to the 1969 Census of Agriculture, 929 farms reported 91,922 cattle, hogs, and sheep on hand. Cattle and calves numbered 41,153. Milk cows numbered 19,869. Also in the county were 224,028 laying hens and pullets and 207,000 broilers.

In 1969, the acreage of principal crops harvested was as follows: corn for grain, 2,560 acres; corn for silage, 7,140 acres; small grain, 9,031 acres; potatoes, 303 acres. In addition, 56,956 acres cut for hay included alfalfa, birdsfoot trefoil, timothy, and various mixtures of clover and grasses.

Numerous industries in and around Wellsboro, Blossburg, Elkland, and Westfield are a source of steady income for families in the county. These industries produce electronic equipment, pipe fittings, wearing apparel, leather, and glass products.

Tioga County is bisected by U.S. Highways 6 and 15. State highways and other blacktop and all-weather roads are in most areas in the county. A major railroad, trucklines, and buses provide the county with shipping facilities and transportation. Airline transportation is within reasonable driving distance.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Tioga County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have about the same profile make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. Wellsboro and Rexford, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Wellsboro channery loam, 8 to 15 percent slopes, is one of several phases within the Wellsboro series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of

this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series or of different phases within one series. Two such kinds of mapping units—soil complexes and undifferentiated groups—are shown on the soil map of the county.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Oquaga-Rock outcrop complex, very steep, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Oquaga and Lordstown soils, very steep, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severly eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called miscellaneous areas and are given descriptive names, such as Alluvial land, which is a miscellaneous area in Tioga County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the survey area. A soil association is a landscape that has a distinctive pattern of soils in defined proportions. It typically consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association can occur in another, but in a different pattern.

A map showing soil associations is useful to people who want to have a general idea of the soils in a survey area, who want to compare different parts of that area, or who want to locate large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide for broad planning on a watershed, a wooded tract, or a wildlife area or for broad planning of recreation facilities, community developments, and such engineering works as transportation corridors. It is not a suitable map for detailed planning for management of a farm or field or for selecting the exact location of a road or building or other structure, because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this survey are described on the pages that follow.

1. Lordstown-Mardin association

Moderately deep and deep, nearly level to very steep, well drained and moderately well drained soils that formed from brownish and olive glacial till; on uplands

This association consists of soils in mountainous areas of the county (fig. 1). It makes up about 23 percent of the county. About 45 percent of this association is Lordstown soils; 20 percent, Mardin soils; and 35 percent, soils of minor extent.

Lordstown soils are moderately deep and well drained. They are on convex tops and sides of mountains.

Mardin soils are deep and moderately well drained. They are on smooth or slightly concave sides and tops of hills and mountains.

The most extensive minor soils are Oquaga, Volusia, and Chippewa soils.

Most of this association is in woodland, and a few previously cultivated areas are reverting to woodland. The main limitations of the soils are depth to bedrock, stoniness, and a seasonal high water table.

2. Volusia-Mardin-Lordstown association

Deep and moderately deep, nearly level to very steep, somewhat poorly drained, moderately well drained, and well drained soils that formed from brownish and olive glacial till; on uplands

This association consists of soils on rolling topography interspered with high ridges (fig. 2). It is the largest association and makes up about 30 percent of the county. About 59 percent of this association is Volusia soils; 12 percent, Mardin soils; 10 percent, Lordstown soils, and 19 percent soils of minor extent.

Volusia soils are deep and somewhat poorly drained.

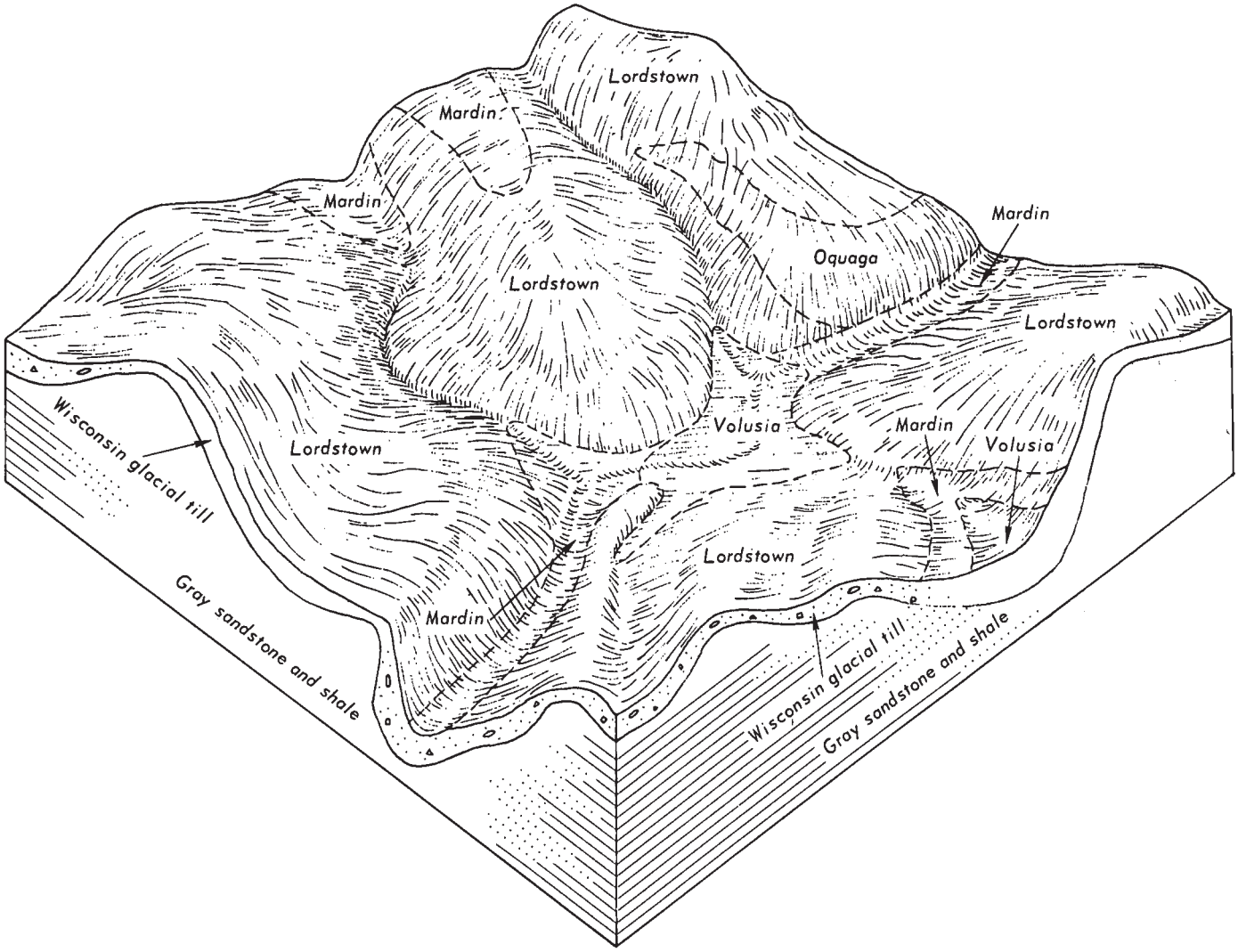

***Figure 1.*—Typical pattern of soils in the Lordstown-Mardin association.**

They are mainly on concave, low-lying side slopes (fig. 3).

Mardin soils are deep and moderately well drained. They are on the middle to upper parts of smooth or slightly concave side slopes.

Lordstown soils are moderately deep and well drained. They are on ridges and the upper slopes. The most extensive minor soils are Chippewa soils.

Much of this association is used for crops, hay, and pasture for use by dairy and livestock cattle. A large number of the wet and steep areas are used for woodland. A few areas, mainly along roads, are used for building sites and other town and country uses. The main limitations of the soils are the seasonal high water table, stoniness, slope, and depth to bedrock.

3. *Morris-Oquaga-Wellsboro association*

Deep and moderately deep, nearly level to very steep, somewhat poorly drained, well drained, and moderately well drained soils that formed from reddish glacial till; on uplands

This association consists of soils in valleys flanked by high ridges (fig. 4). It makes up about 8 percent of the county. About 35 percent of this association is Morris soils; 30 percent, Oquaga soils; 28 percent, Wellsboro soils; and 7 percent, soils of minor extent.

Morris soils are deep and somewhat poorly drained. They are on the lower concave slopes (fig. 5).

Oquaga soils are moderately deep and well drained. They are on the convex upper slopes and on ridgetops.

Wellsboro soils are deep and moderately well drained. They are on the smooth and slightly concave middle slopes.

The most extensive minor soils are Norwich and Lackawanna soils.

Much of this association is used for woodland. Some

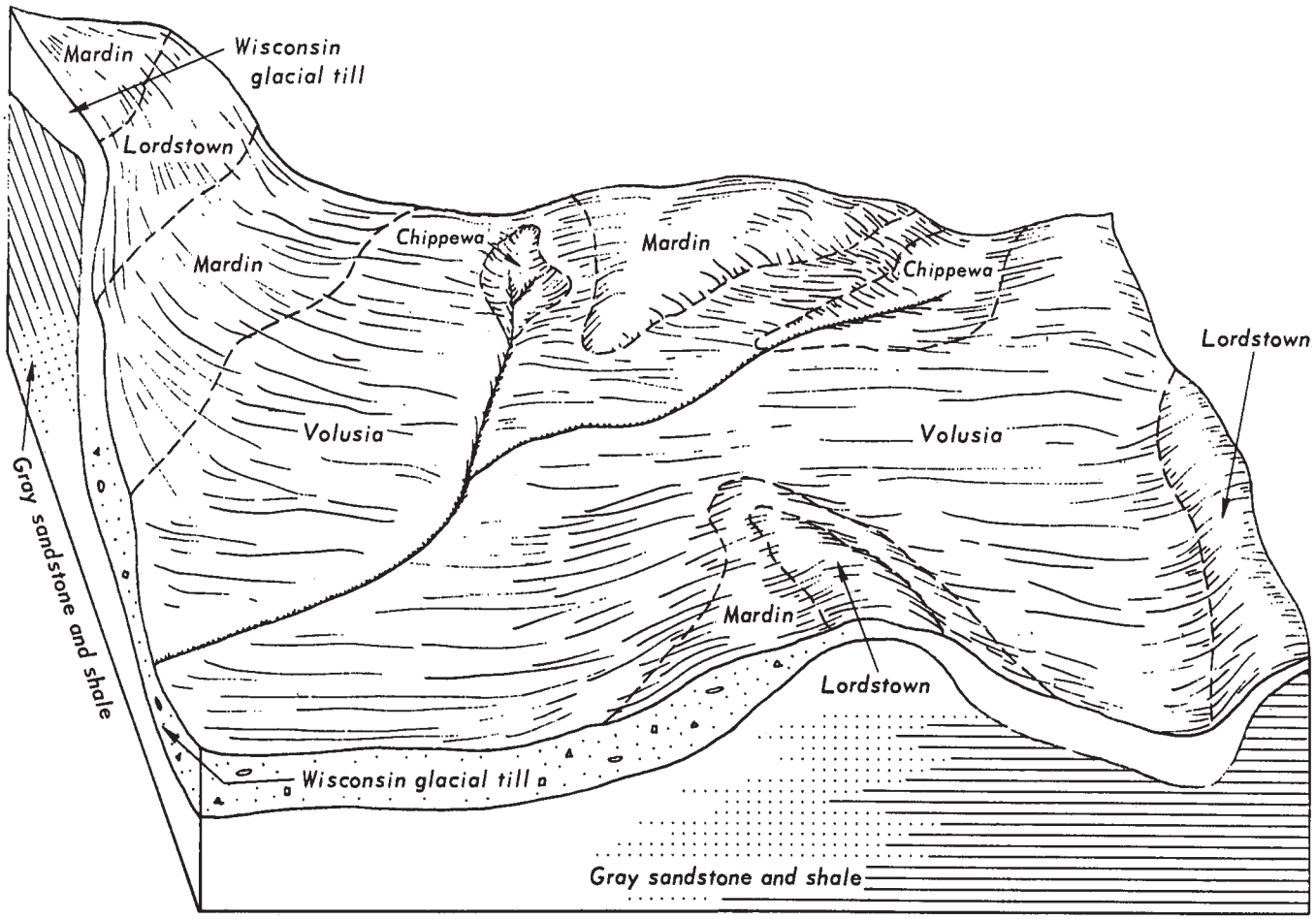

Figure 2.—**Typical pattern of soils in the Volusia-Mardin-Lordstown association.**

areas are used for crops, hay, and pasture for use by dairy cattle. The wetter and steeper areas are nearly all in woodland. A few areas are used for building sites. The main limitations of the soils are the seasonal high water table, depth to bedrock, coarse fragments, and slope.

4. *Oquaga-Morris association*

Moderately deep and deep, nearly level to very steep, well drained and somewhat poorly drained soils that formed from reddish glacial till; on uplands

This association consists of soils on rolling topography and high ridges. It makes up about 9 percent of the county. About 54 percent of this association is Oquaga soils; 22 percent, Morris soils; and 24 percent, soils of minor extent.

Oquaga soils are moderately deep and well drained. They are on the convex upper slopes and ridgetops.

Morris soils are deep and somewhat poorly drained. They are on the concave lower slopes.

The most extensive minor soils are Norwich, Wellsboro, Lackawanna, and Orrville soils.

Most of this association is in woodland. A few areas are used for crops for use by dairy cattle. The main limitations of the soils are stoniness, a seasonal high water table, and depth to bedrock.

5. *Oquaga-Lordstown association*

Moderately deep, gently sloping to very steep, well drained soils that formed from brownish and reddish glacial till; on uplands

This association consists of soils in mountainous areas of the county (fig. 6). It makes up about 22 percent of the county. About 51 percent of this association is Oquaga soils; 20 percent, Lordstown soils; and 29 percent, soils of minor extent.

Oquaga soils are moderately deep and well drained. They are on the lower and middle slopes of the mountains.

Lordstown soils are also moderately deep and well drained. They are on the upper slopes and tops of mountains.

The most extensive minor soils are Wellsboro, Mardin, and Morris soils.

Nearly all of this association is in woodland. The main limitations of the soils are the slope, stoniness, and depth to bedrock.

6. *Dekalb-Clymer association*

Moderately deep and deep, gently sloping to very steep, well drained soils that formed from material that weathered from sandstone and some siltstone and shale; on uplands

This association consists of soils in the stream-dissected plateau area of the county. It is the smallest association and makes up about 2 percent of the county. About 55 percent of this association is Dekalb soils; 35 percent, Clymer soils; and 10 percent, soils of minor extent.

Dekalb soils are moderately deep and well drained. They are on the sides and tops of ridges and mountains.

Clymer soils are deep and well drained. They are on the broad tops of mountains and ridges.

The most extensive minor soils are Cookport soils.

Nearly all of this association is in woodland. The main limitations of the soils are stoniness, depth to bedrock, and slope.

7. *Pope-Chenango-Orrville association*

Deep, nearly level to moderately steep; somewhat excessively drained, well drained, and somewhat poorly drained soils that formed from alluvium and water-sorted sand and gravel; on flood plains and terraces

This association consists of soils in stream valleys throughout the county. It makes up about 6 percent of the county. About 25 percent of this association is Pope soils; 24 percent, Chenango soils; 16 percent, Orrville soils; and 35 percent, soils of minor extent.

Pope soils are well drained. They are adjacent to the stream channel.

Chenango soils are well drained to somewhat excessively drained. They are in rolling areas on the terraces.

Orrville soils are somewhat poorly drained. They are in the lower and backwater areas of flood plains.

The most extensive minor soils are Philo, Wyoming, Wayland, and Carlisle soils.

Most of this association is used for crops. Some areas are used as sites for homes and communities. The main limitations of the soils are the flooding hazard and a seasonal high water table.

Figure 3.—**Typical landscape of the Volusia-Mardin-Lordstown association. Volusia soils are in the foreground, and Mardin and Lordstown soils are in the background.**

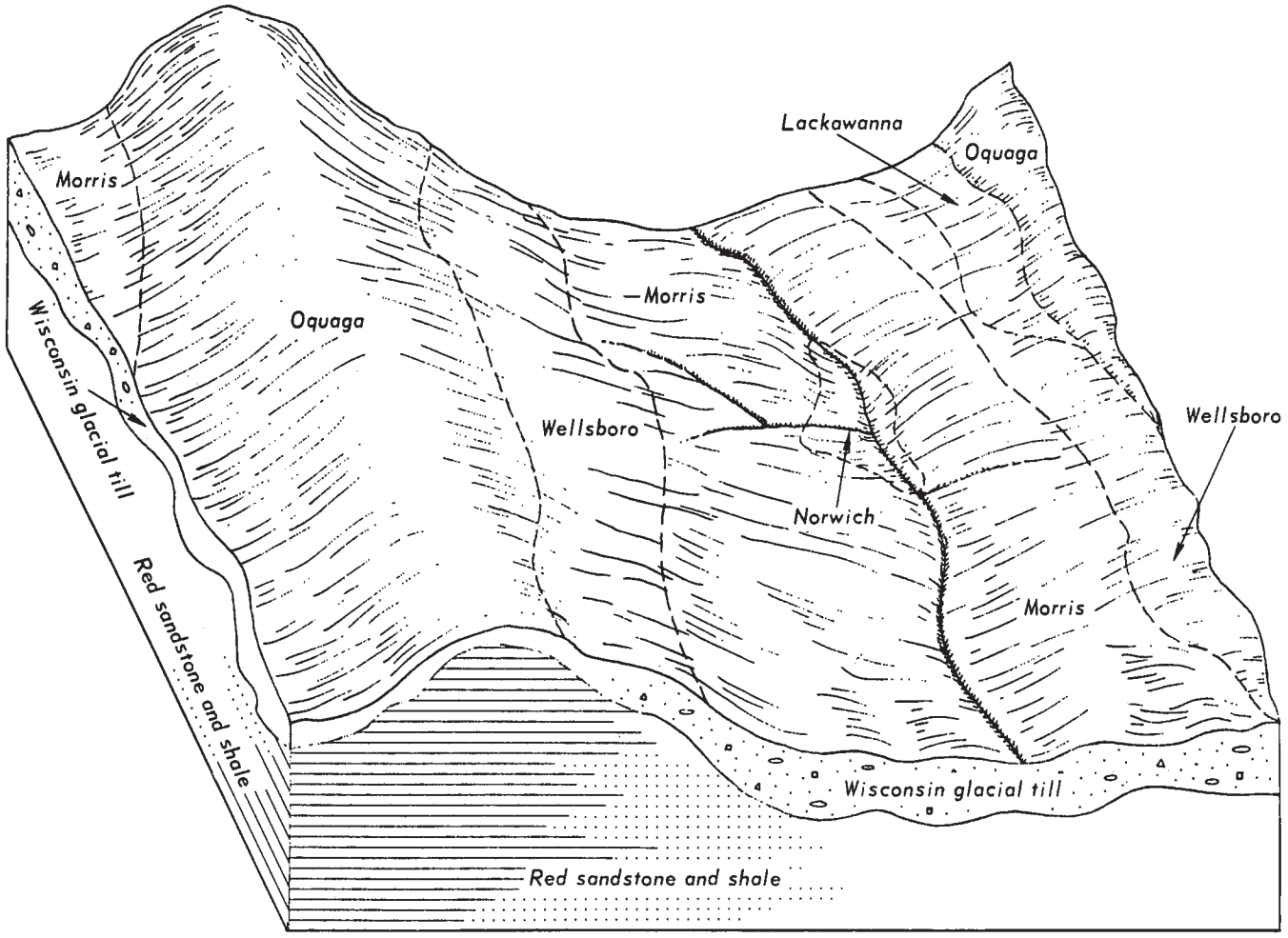

***Figure 4.*—Typical pattern of soils in the Morris-Oquaga-Wellsboro association.**

Description of the Soils

This section describes each soil series in detail and then, briefly, each mapping unit in that series. Unless stated otherwise, what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface down to rock or other underlying material. Each series contains two descriptions of the profile. The first is brief and in terms familiar to a layman. The second is more detailed and is included for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for moist soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Alluvial land, for example, does not belong to a soil series, but nevertheless, it is listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit has been placed.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*9*).[1]

Some of the boundaries of the Tioga County detailed soil map do not match those in earlier surveys because

[1] Italic numbers in parentheses refer to Literature Cited, p. 93.

of changes in the concept of some series, differing soil patterns observed between adjacent counties, and differing degrees of soil separation.

Alluvial Land

Ab—Alluvial land. This is a nearly level and gently sloping miscellaneous area that consists of alluvial deposits along streams. The deposits are silt, sand, clay, and varying amounts of gravel, cobblestones, and stones. The areas are long and narrow and 3 to 100 acres or more in size. The slope is 0 to 3 percent. Alluvial land is well drained to very poorly drained. It is subject to frequent flooding.

Included in mapping were small areas of Pope and Orrville soils.

Most areas are used for woodland, but some areas are used for pasture. Alluvial land is best suited to trees, wildlife habitat, or pasture. The flooding hazard is a limitation to most uses. Capability unit VIw–1.

Arnot Series

The Arnot series consists of shallow, well drained soils on the uplands. These soils are gently sloping and are on glacially swept mountaintops. They formed in glacial till derived from sandstone and shale.

In a representative profile in woodland, 2 inches of organic material overlies a surface layer of dark grayish brown channery loam about 2 inches thick. The subsoil is yellowish brown and dark yellowish brown, very friable and friable channery loam 13 inches thick. The substratum is yellowish brown very channery silt loam 4 inches thick. Sandstone bedrock is at a depth of about 19 inches.

The available water capacity is very low, and permeability is moderate to rapid. Droughtiness, coarse fragments, depth to bedrock, and rockiness are the main limitations to use.

Representative profile of Arnot channery loam, 3 to 12 percent slopes, in a woodlot, 3.5 miles southeast of Sabinsville in Clymer Township (Sample number BK–38506 in soil test data table) :

O2—2 inches to 0; black (10YR 2/1) partly decomposed organic matter.

A1—0 to 2 inches; dark grayish brown (10YR 4/2) channery loam; weak fine granular structure; very friable; nonsticky and slightly plastic; many roots; 20 percent coarse fragments; strongly acid; clear wavy boundary.

B21—2 to 9 inches; yellowish brown (10YR 5/4)

Figure 5.—Typical landscape of the Morris-Oquaga-Wellsboro association. Morris and Wellsboro soils are in the foreground, and Oquaga soils are in the wooded areas.

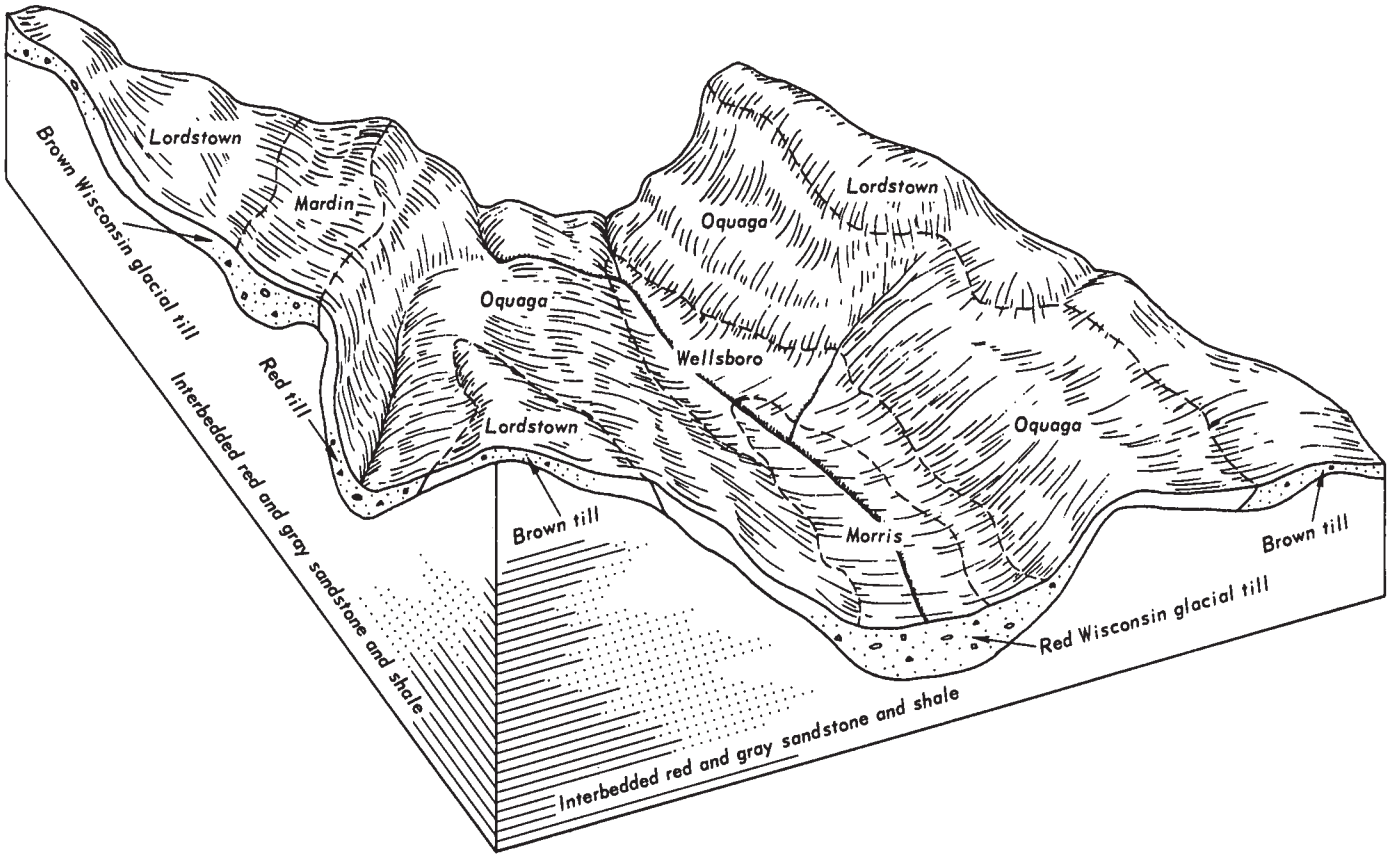

Figure 6.—**Typical pattern of soils in the Oquaga-Lordstown association.**

channery loam; weak fine subangular blocky structure; very friable; slightly sticky and slightly plastic; many roots; 35 percent coarse fragments; strongly acid; gradual wavy boundary.

B22—9 to 15 inches; dark yellowish brown (10YR 4/4) channery loam; weak fine subangular blocky structure; friable; slightly sticky and slightly plastic; few roots; 40 percent coarse fragments; strongly acid; gradual wavy boundary.

C—15 to 19 inches; yellowish brown (10YR 5/4) very channery silt loam; massive; friable; slightly sticky and slightly plastic; few roots; 70 percent coarse fragments; strongly acid; abrupt wavy boundary.

R—19 inches; sandstone bedrock.

The solum is 10 to 20 inches thick. The content of coarse fragments ranges from 20 to 50 percent in the A horizon, 35 to 50 percent in the B horizon, and 50 to 70 percent in the C horizon. The A1 horizon ranges from dark grayish brown (10YR 4/2) to reddish brown (5YR 4/3). The B horizon ranges from dark yellowish brown (10YR 4/4) to light reddish brown (5YR 6/3). The fine earth part of the B horizon and C horizon is loam to silt loam, and reaction is very strongly acid or strongly acid.

Arnot soils are near the moderately deep, well drained Oquaga and Lordstown soils. Some other nearby soils, which have a Bx horizon, are Mardin, Wellsboro, Volusia, and Morris soils. Arnot soils are shallower to bedrock than all these soils.

AoB—Arnot channery loam, 3 to 12 percent slopes. This soil is gently sloping and is on the tops of glacially swept mountains. Areas are oblong or irregular in shape and 3 to 100 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were small areas of nearly level and sloping Arnot soils. Also included were a few areas of shallow soils that have a sandy loam subsoil and some areas of Lordstown and Oquaga soils. In some areas Rock outcrop was also included.

Most areas of this soil are used for woodland, but a small acreage has been cleared and is used for pasture or is idle. The soil is suited to hay, pasture, woodland, or wildlife habitat. It can be used for crops, but the choice is somewhat limited and management is needed to prevent erosion. The depth to bedrock, coarse fragments, and droughtiness are limitations to many uses. Capability unit IIIe–5.

ArB—Arnot-Rock outcrop complex, 3 to 12 percent slopes. This mapping unit is gently sloping and is on the tops of glacially swept mountains. It is about 60 percent Arnot channery loam and 20 to 30 percent Rock

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Alluvial land	6,045	1.0
Arnot channery loam, 3 to 12 percent slopes	2,120	.3
Arnot-Rock outcrop complex, 3 to 12 percent slopes	940	.1
Bath channery silt loam, 3 to 12 percent slopes	1,490	.2
Bath very stony loam, 3 to 12 percent slopes	15,910	2.2
Braceville gravelly loam, 3 to 8 percent slopes	1,710	.2
Carlisle silt loam	865	.1
Chenango gravelly loam, 2 to 12 percent slopes	10,400	1.4
Chenango gravelly loam, 12 to 20 percent slopes	2,065	.3
Chenango gravelly loam, 20 to 30 percent slopes	900	.1
Chippewa silt loam, 0 to 3 percent slopes	3,370	.5
Chippewa silt loam, 3 to 8 percent slopes	4,255	.6
Chippewa very stony silt loam, 0 to 8 percent slopes	2,955	.4
Clymer channery loam, 3 to 12 percent slopes	2,600	.3
Clymer very stony loam, 3 to 12 percent slopes	3,520	.5
Cookport very stony loam, 0 to 8 percent slopes	1,350	.2
Dekalb channery loam, 3 to 12 percent slopes	2,480	.3
Dekalb channery loam, 12 to 20 percent slopes	605	.1
Dekalb extremely stony loam, 3 to 12 percent slopes	1,015	.1
Dekalb extremely stony loam, 12 to 30 percent slopes	3,295	.4
Dekalb extremely stony loam, 30 to 70 percent slopes	4,445	.6
Kanona silt loam, 3 to 8 percent slopes	2,975	.4
Kanona silt loam, 8 to 15 percent slopes	1,775	.2
Kanona silty clay loam, 15 to 25 percent slopes, eroded	840	.1
Lackawanna channery loam, 3 to 12 percent slopes	1,280	.2
Lackawanna channery loam, 12 to 20 percent slopes	630	.1
Lordstown channery loam, 3 to 12 percent slopes	28,245	3.8
Lordstown channery loam, 12 to 20 percent slopes	14,370	2.0
Lordstown channery loam, 20 to 30 percent slopes	15,910	2.2
Lordstown very stony loam, 3 to 12 percent slopes	18,030	2.5
Lordstown very stony loam, 12 to 30 percent slopes	27,645	3.8
Mardin channery silt loam, 0 to 3 percent slopes	935	.1
Mardin channery silt loam, 3 to 8 percent slopes	9,820	1.3
Mardin channery silt loam, 8 to 15 percent slopes	11,370	1.5
Mardin channery silt loam, 15 to 25 percent slopes	15,905	2.2
Mardin very stony silt loam, 0 to 8 percent slopes	19,405	2.6
Mardin very stony silt loam, 8 to 25 percent slopes	7,395	1.0
Morris gravelly silt loam, 0 to 3 percent slopes	2,085	0.3
Morris gravelly silt loam, 3 to 8 percent slopes	14,675	2.0
Morris gravelly silt loam, 8 to 15 percent slopes	16,025	2.2
Morris gravelly silt loam, 15 to 25 percent slopes	2,645	.4
Morris very stony silt loam, 0 to 8 percent slopes	3,380	.5
Morris very stony silt loam, 8 to 25 percent slopes	3,915	.5
Norwich silt loam	1,230	.2
Norwich very stony silt loam	815	.1
Oquaga channery loam, 3 to 12 percent slopes	24,310	3.3
Oquaga channery loam, 12 to 20 percent slopes	26,360	3.6
Oquaga channery loam, 20 to 30 percent slopes	27,145	3.7
Oquaga very stony loam, 3 to 12 percent slopes	1,930	.3
Oquaga very stony loam, 12 to 30 percent slopes	19,050	2.6
Oquaga and Lordstown soils, very steep	116,385	15.9
Oquaga-Rock outcrop complex, very steep	3,690	.5
Orrville silt loam	9,060	1.2
Philo silt loam	2,830	.4
Pope soils	9,915	1.3
Pope fine sandy loam, high bottom	1,560	.2
Rexford silt loam, 0 to 3 percent slopes	770	.1
Rexford silt loam, 3 to 10 percent slopes	1,160	.2
Stony land, wet	1,860	.2
Volusia channery silt loam, 0 to 3 percent slopes	2,685	.4
Volusia channery silt loam, 3 to 8 percent slopes	38,700	5.3
Volusia channery silt loam, 8 to 15 percent slopes	70,960	9.7
Volusia channery silt loam, 15 to 25 percent slopes	17,110	2.3
Volusia channery silt loam, 15 to 25 percent slopes, eroded	4,280	.6
Volusia channery silt loam, 25 to 35 percent slopes, eroded	3,940	.5
Volusia very stony silt loam, 0 to 8 percent slopes	7,090	1.0
Volusia very stony silt loam, 8 to 25 percent slopes	1,570	.2
Volusia extremely stony silt loam, 0 to 8 percent slopes	625	.1
Volusia channery silt loam, silty substratum, 3 to 8 percent slopes	1,225	.2
Volusia channery silt loam, silty substratum, 8 to 15 percent slopes	1,205	.2
Volusia channery silt loam, silty substratum, 15 to 25 percent slopes, eroded	1,410	.2
Wayland silty clay loam	1,625	.2
Wellsboro channery loam, 0 to 3 percent slopes	1,340	.2
Wellsboro channery loam, 3 to 8 percent slopes	9,525	1.3
Wellsboro channery loam, 8 to 15 percent slopes	10,925	1.5
Wellsboro channery loam, 15 to 25 percent slopes	3,510	.5
Wellsboro very stony loam, 0 to 8 percent slopes	3,030	.4

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Wellsboro very stony loam, 8 to 25 percent slopes	2,575	0.3	Wyoming gravelly loam, flooded	2,670	0.4
Wyoming gravelly sandy loam, 12 to 20 percent slopes	1,090	.1	Strip mine	3,080	.4
Wyoming gravelly sandy loam, 20 to 30 percent slopes	980	.1	Mine dump	220	(1)
Wyoming gravelly sandy loam, 30 to 50 percent slopes	2,160	.3	Gravel pit	80	(1)
			Tannery wastes	170	(1)
			Total	733,440	100.0

[1] Less than 0.05 percent.

outcrop. The Rock outcrop is exposures of sandstone bedrock. Areas are irregular in shape and 3 to 50 acres or more in size.

Included in mapping were small areas of Lordstown and Oquaga soils.

This mapping unit is used for woodland. It is best suited to woodland or wildlife habitat. Rock outcrop prevents use for crops. The depth to bedrock and Rock outcrop are limitations to most uses. Capability units VIIs-2.

Bath Series

The Bath series consists of deep, well drained soils on the uplands. These soils are gently sloping and are on convex side slopes, benches, and tops of hills and mountains. They formed in glacial till derived from gray and brown sandstone, siltstone, and shale.

In a representative profile in a cultivated field, the surface layer is dark brown, friable channery silt loam about 9 inches thick. The upper 22 inches of the subsoil is yellowish brown and brown, friable and firm channery silt loam and channery loam; and the lower 12 inches is dark yellowish brown, very firm and brittle channery loam. The substratum is brown channery loam between depths of 43 and 60 inches.

The available water capacity is moderate, and permeability is slow. The slow permeability, coarse fragments, and stoniness are the main limitations to use.

Representative profile of Bath channery silt loam, 3 to 12 percent slopes, in a cultivated field, 0.5 mile north of East Point in Liberty Township:

Ap—0 to 9 inches; dark brown (10YR 3/3) channery silt loam; weak fine and medium granular structure; very friable, nonsticky and slightly plastic; many roots; 15 percent coarse fragments; neutral; abrupt wavy boundary.

B21—9 to 20 inches; yellowish brown (10YR 5/4) channery silt loam; weak fine and medium subangular blocky structure; friable, slightly sticky and slightly plastic; common roots; 15 percent coarse fragments; medium acid; gradual wavy boundary.

B22—20 to 26 inches; yellowish brown (10YR 5/4) channery loam; weak medium subangular blocky structure; friable, nonsticky and slightly plastic; few roots; 15 percent coarse fragments; strongly acid; gradual wavy boundary.

B23—26 to 31 inches; brown (7.5YR 4/4) channery loam; weak medium platy structure; firm; few roots; 15 percent coarse fragments; strongly acid; clear wavy boundary.

Bx—31 to 43 inches; dark yellowish brown (10YR 4/4) channery loam; many fine and medium distinct strong brown (7.5YR 5/8) and light brownish gray (10YR 6/2) mottles; weak very coarse prismatic structure parting to moderate thick platy and moderate medium subangular blocky; very firm and brittle, slightly sticky and slightly plastic; few thin clay films in pores; 35 percent coarse fragments; strongly acid; gradual wavy boundary.

C—43 to 60 inches; brown (7.5YR 5/4) channery loam; massive; firm, nonsticky and nonplastic; 30 percent coarse fragments; strongly acid.

The solum is 40 to 60 inches thick. Depth to bedrock ranges from 40 inches to many feet. Depth to the fragipan ranges from 26 to 36 inches. The content of coarse fragments, mainly angular and subangular sandstone, is 15 to 30 percent in the Ap horizon and B2 horizon and 20 to 60 percent in the Bx horizon. The Ap horizon ranges from very dark grayish brown (10YR 3/2) to brown (10YR 5/3). The B2 horizon is yellowish brown (10YR 5/6) to brown (7.5YR 4/4). The fine earth part ranges from silt loam to loam. The Bx horizon ranges from light olive brown (2.5Y 5/6) to brown (7.5YR 4/4). In places, it has light brownish gray (10YR 6/2) prism faces and strong brown (7.5YR 5/6) rinds. The fine earth part ranges from silt loam to loam. The Bx horizon is very strongly acid to slightly acid. The C horizon is similar in color and texture to the Bx horizon. It is strongly acid to moderately alkaline.

Bath soils are near Lordstown, Mardin, and Volusia soils. They are better drained than Mardin and Volusia soils, and they are deeper than Lordstown soils.

BaB—Bath channery silt loam, 3 to 12 percent slopes. This soil is gently sloping and is on hilltops,

mountaintops, and side slopes. Areas are irregular in shape and 3 to 50 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were small areas of nearly level Bath soils and a few small areas of gently sloping Lordstown and Mardin soils. The slow permeability is a limitation to some uses. Capability unit IIe–1.

BsB—Bath very stony loam, 3 to 12 percent slopes. This soil is gently sloping and is on hilltops, benches, mountaintops, and side slopes. Areas of this soil are irregular in shape and 25 to 200 acres or more in size. About 5 to 15 percent of the surface is covered by stones and boulders. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thin and undisturbed.

Included in mapping were a few small areas of Lordstown and Mardin soils.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated, but it can be used for permanent pasture. It is suited to woodland and wildlife habitat. The slow permeability and stoniness are limitations to most uses. Capability unit VIs–1.

Braceville Series

The Braceville series consists of deep, moderately well drained soils on glacial outwash terraces. These soils are gently sloping and are on the fringe of stream valleys. They formed in water-sorted gravelly material derived from sandstone, siltstone, and shale.

In a representative profile in a cultivated field, the surface layer is dark brown gravelly loam about 8 inches thick. The subsoil extends to a depth of 34 inches. The upper 16 inches is yellowish brown and brown, friable and firm gravelly loam that has light brownish gray and strong brown mottles at a depth of 16 inches. The lower 10 inches is brown, very firm and brittle gravelly loam that has common gray, strong brown, and yellowish red mottles. The substratum is yellowish brown stratified sand and gravel to a depth of 60 inches.

The available water capacity is moderate, and permeability is moderately slow. A seasonal water table rises to within 18 to 36 inches of the surface during wet periods. The moderately slow permeability and seasonal high water table are the main limitations to use.

Representative profile of Braceville gravelly loam, 3 to 8 percent slopes, in a cultivated field 1.5 miles southwest of Knoxville in Deerfield Township:

Ap—0 to 8 inches; dark brown (10YR 3/3) gravelly loam; weak fine granular structure; very friable, nonsticky and slightly plastic; many roots; 15 percent coarse fragments; medium acid; clear wavy boundary.

B21—8 to 16 inches; yellowish brown (10YR 5/4) gravelly loam; weak fine subangular blocky structure; friable, slightly sticky and slightly plastic; many roots; 20 percent coarse fragments; strongly acid; clear wavy boundary.

B22—16 to 24 inches; brown (10YR 5/3) gravelly loam; common fine distinct light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm, slightly sticky and slightly plastic; few thin clay films in pores; 25 percent coarse fragments; strongly acid; clear wavy boundary.

Bx—24 to 34 inches; brown (10YR 5/3) gravelly loam; common fine prominent gray (10YR 6/1), strong brown (7.5YR 5/8), and yellowish red (5YR 5/8) mottles; weak very coarse prismatic structure parting to moderate thick platy and moderate medium subangular blocky; very firm and brittle, slightly sticky and slightly plastic; few thick clay films in pores; 25 percent coarse fragments; strongly acid; clear wavy boundary.

IIC—34 to 60 inches; yellowish brown (10YR 5/6) stratified sand and gravel; few thin gray (N 5/0) streaks and mottles; single grained; friable, nonsticky and nonplastic; strongly acid.

The solum is 30 to 40 inches thick. Depth to bedrock ranges from 5 to 10 feet or more. Depth to the fragipan is 20 to 30 inches. The content of coarse fragments ranges from 15 to 30 percent in the Ap horizon and B2 horizon and from 20 to 50 percent in the Bx horizon. The Ap horizon is dark brown (10YR 3/3) or brown (10YR 4/3). The B horizon ranges from brown (10YR 4/3) to light olive brown (2.5Y 5/6). Low-chroma mottles begin at a depth of 16 to 30 inches. The fine earth part ranges from silt loam to loam or sandy loam.

Braceville soils are near Wyoming, Chenango, and Rexford soils. Pope and Philo soils are on nearby flood plains. Braceville soils contain less gravel and are not so well drained as Wyoming and Chenango soils, and they are better drained than Rexford soils. They contain more coarse fragments than Pope and Philo soils.

BvB—Braceville gravelly loam, 3 to 8 percent slopes. This soil is gently sloping and is on outwash terraces. Areas are elongated and irregular in shape and 3 to 40 acres in size.

Included with this soil in mapping were some areas of nearly level and sloping Braceville soils and soils that are less than 15 percent gravel. Also included were small areas of Chenango, Wyoming, and Rexford soils.

Most areas are used for crops or pasture. The soil is suited to most cultivated crops commonly grown in the county. Alfalfa and winter grain are subject to frost-heave damage. The gentle slopes and accessibility have encouraged some use of this soil for town and country uses. A seasonal high water table and moderately slow permeability are limitations to most uses. Capability unit IIw–2.

Carlisle Series

The Carlisle series consists of deep, very poorly drained soils. These soils are nearly level and are on flood plains, in depressions on outwash terraces and mountaintops, and at the head of streams. They formed in deposits of decayed sedges, reeds, cattails, leaves, and woody plants.

In a representative profile the surface layer is black

silt loam about 8 inches thick. In sequence, the next layers are 24 inches of black muck (sapric material), 8 inches of dark brown peat (fibric material), and 17 inches of black and very dark brown muck. The underlying material is dark brown silt and gray silty clay loam between depths of 57 and 109 inches.

The available water capacity is high, and permeability is moderately rapid. A high water table is at the surface during most of the year. The high water table and flooding hazard are the main limitations to use.

Representative profile of Carlisle silt loam in a hayfield 5.6 miles west of Wellsboro along Route 6 in Delmar Township:

Ap1—0 to 3 inches; black (10YR 2/1) silt loam; moderate fine and medium granular structure; strongly acid; clear smooth boundary.

Ap2—3 to 8 inches; black (10YR 2/1) silt loam; weak coarse subangular blocky structure parting to moderate fine and medium granular; very friable, slightly plastic; strongly acid; clear smooth boundary.

Oa1—8 to 14 inches; black (10YR 2/1) when broken, pressed, and rubbed sapric material; about 8 percent fibers unrubbed and less than 1 percent when rubbed; weak coarse prismatic structure; friable; 25 percent mineral; very strongly acid; gradual wavy boundary.

Oa2—14 to 24 inches; black (10YR 2/1) when broken, pressed, and rubbed sapric material; about 15 percent fibers unrubbed and less than 5 percent when rubbed; weak coarse prismatic structure; friable; 25 percent mineral; very strongly acid; clear wavy boundary.

Oa3—24 to 32 inches; black (10YR 2/1) when broken, pressed, and rubbed sapric material; about 30 percent fibers unrubbed and 5 percent when rubbed; massive; friable; 15 percent mineral; strongly acid; abrupt wavy boundary.

Oi—32 to 40 inches; dark brown (7.5YR 4/4) when broken, reddish brown (5YR 4/3) when pressed, and dark reddish brown (5YR 3/3) when rubbed fibric material; massive; friable; 5 percent mineral; strongly acid; abrupt wavy boundary.

Oa4—40 to 48 inches; black (10YR 2/1) when broken, pressed, and rubbed sapric material; about 20 percent fibers unrubbed and less than 5 percent when rubbed; massive; friable; 40 percent mineral; medium acid; clear wavy boundary.

Oa5—48 to 57 inches; very dark brown (10YR 2/2) when broken, pressed, and rubbed sapric material; about 20 percent fibers unrubbed and 10 percent when rubbed; massive; friable; 60 percent mineral; medium acid; abrupt wavy boundary.

IIC1—57 to 102 inches; dark brown (10YR 3/3) silt; massive; friable; medium acid; abrupt wavy boundary.

IIC2—102 to 109 inches; gray (5Y 5/1) silty clay loam; massive; firm, slightly sticky and plastic; slightly acid.

The organic layers are more than 51 inches thick. Depth to bedrock is 5 to 25 feet. Most of the horizons are mainly herbaceous, but horizons containing woody fragments are common. The Ap horizon is 6 to 15 inches thick. Horizons within the subsurface and bottom tiers are black (10YR 2/1) to reddish brown (5YR 4/4).

Carlisle soils in Tioga County contain more fibric material in the profile than is permitted in the range of the series. This difference, however, does not alter their use, management, or behavior.

Carlisle soils are near Wayland and Orrville soils. Carlisle soils are organic, and Wayland and Orrville soils are mineral soils.

CA—Carlisle silt loam. This soil is nearly level and is on flood plains, on outwash terraces, at heads of streams, and in depressions on mountaintops. The slope is 0 to 3 percent. Areas are irregular in shape and 3 to 100 acres or more in size.

Included in mapping were small areas of soils that have mineral material at a depth of less than 51 inches.

About half the acreage has been drained and cultivated. If it is drained and the water level is controlled (fig. 7), this soil is suited to most crops including truck crops. If undrained, it is best suited to wildlife habitat. A high water table and flooding hazard are limitations for most uses. Capability unit IIIw–1.

Chenango Series

The Chenango series consists of deep, well drained to somewhat excessively drained soils on glacial outwash terraces. These soils are nearly level to moderately steep and are mainly within and along the fringes of stream valleys. They formed in water-sorted sand and gravel derived from gray and brown sandstone, siltstone, and shale.

In a representative profile in a subdivision development, the surface layer is dark brown gravelly loam about 5 inches thick. The subsoil extends to a depth of 30 inches. The upper 16 inches is yellowish brown and dark yellowish brown, very friable and friable gravelly loam; and the lower 9 inches is dark brown, friable very gravelly sandy loam. The substratum is dark brown stratified sand and gravel to a depth of 80 inches.

The available water capacity is low, and permeability is moderate in the subsoil and very rapid in the substratum. Droughtiness, coarse fragments, and slope are the main limitations to use.

Representative profile of Chenango gravelly loam, 2 to 12 percent slopes, in a subdivision development north of Arnot in Bloss Township (Sample numbers BK–36395 and BK–36396 in table 9):

Ap—0 to 5 inches; dark brown (10YR 3/3) gravelly loam; weak fine granular structure; very friable; many roots; 20 percent coarse fragments; medium acid; abrupt wavy boundary.

B21—5 to 12 inches; yellowish brown (10YR 5/6) gravelly loam; weak medium granular structure; very friable; common

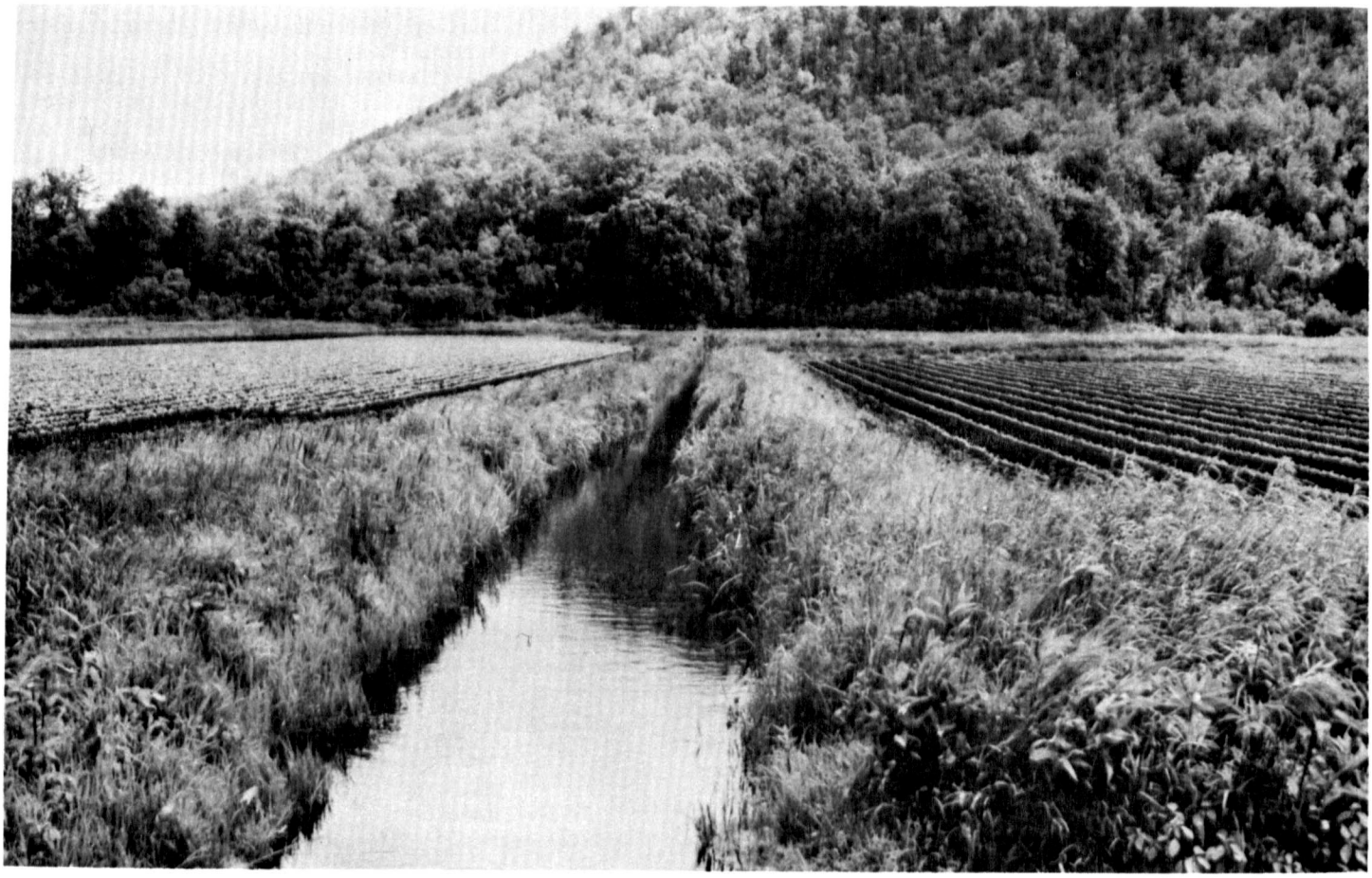

Figure 7.—**If drained, Carlisle soils are suitable for growing vegetables. Lordstown and Oquaga soils are on the wooded slopes in the background.**

roots; 20 percent coarse fragments; strongly acid; clear wavy boundary.

B22—12 to 21 inches; dark yellowish brown (10YR 4/4) gravelly loam; weak fine subangular blocky structure; friable, slightly sticky and slightly plastic; few roots; 35 percent coarse fragments; strongly acid; clear wavy boundary.

B3—21 to 30 inches; dark brown (10YR 4/3) very gravelly sandy loam; weak fine subangular blocky structure; friable, nonsticky and nonplastic; few roots; 60 percent coarse fragments; strongly acid; clear wavy boundary.

IIC—30 to 80 inches; dark brown (10YR 4/3) stratified sand and gravel; single grained; nonsticky and nonplastic; strongly acid.

The solum is 24 to 36 inches thick. Depth to bedrock is more than 40 inches and is generally more than 10 feet. The content of coarse fragments of gravel and cobblestones ranges from 20 to 60 percent in the B horizon. The Ap horizon ranges from dark brown (10YR 3/3) to grayish brown (10YR 5/2). The B horizon ranges from yellowish brown (10YR 5/6) to dark brown (10YR 4/3). The fine earth part of the B2 horizon ranges from fine sandy loam to silt loam.

Chenango soils are near Wyoming, Braceville, and Rexford soils on outwash terraces and Pope and Philo soils on flood plains. Chenango soils contain more silt and less sand than Wyoming soils; they are better drained than Braceville, Rexford, and Philo soils; and they contain more gravel than Pope soils.

ChB—Chenango gravelly loam, 2 to 12 percent slopes. This soil is nearly level and gently sloping and is on outwash terraces and fans, mainly in stream valleys. Areas are irregular in shape and 3 to 50 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were a few areas of Wyoming and Braceville soils. Also included were a few alluvial fans, recently deposited by small streams, which are subject to occasional flooding.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is droughty, but it is suited to most of the cultivated crops, grasses, and legumes commonly grown in the county. The coarse fragments are a limitation to some uses. Ground water may be contaminated if the soil is used for sewage effluent disposal. Capability unit IIs–1.

ChC—Chenango gravelly loam, 12 to 20 percent slopes. This soil is sloping and is mainly on outwash terraces in stream valleys. Areas are irregular in shape and 3 to 40 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the solum is a few inches thinner.

Included with this soil in mapping were some small areas of gently sloping and moderately steep Chenango soils. Also included were some areas of sloping Wyoming soils.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is droughty, but it is suited to most of the cultivated crops, grasses, and legumes grown in the area. Erosion control is needed. The slope is a limitation to most uses. Ground water may be contaminated if the soil is used for sewage effluent disposal. Capability unit IIIe–1.

ChD—Chenango gravelly loam, 20 to 30 percent slopes. This soil is moderately steep and is on outwash terraces, mainly in stream valleys. Areas are oblong or irregular in shape and 3 to 30 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the solum is a few inches thinner.

Included in mapping were some areas of sloping Chenango soils and moderately steep Wyoming soils.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is suited to hay or pasture and to limited cultivation. Erosion control is needed. The slope is a limitation to most uses. Ground water may be contaminated if the soil is used for sewage effluent disposal. Capability unit IVe–1.

Chippewa Series

The Chippewa series consists of deep, poorly drained soils on the uplands. These soils are nearly level and gently sloping and are at the base of steeper slopes, in depressions, and along drainageways and stream heads. They formed in glacial till derived from grayish brown sandstone, siltstone, and shale that has a limestone or calcareous component.

In a representative profile in a cultivated field the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer is 5 inches of grayish brown, friable silt loam that has common yellowish brown mottles. The subsoil is olive gray, dark grayish brown and gray, very firm and brittle channery silt loam 28 inches thick. It has gray, grayish brown, brownish yellow, and light olive brown mottles. The substratum is gray channery silt loam between depths of 40 and 58 inches.

The available water capacity is moderate, and permeability is very slow. A high water table is at or near the surface during much of the year. The very slow permeability and high water table are the main limitations to use.

Representative profile of a Chippewa silt loam, 3 to 8 percent slopes, in a cultivated field 1.0 mile east of Jackson Summit in Jackson Township:

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam; weak fine granular structure; friable, nonsticky and slightly plastic; many roots; 10 percent coarse fragments; medium acid; abrupt smooth boundary.

A2g—7 to 12 inches; grayish brown (2.5Y 5/2) silt loam; common medium distinct yellowish brown (10YR 5/4 and 10YR 5/8) mottles; weak medium subangular blocky structure; friable, nonsticky and slightly plastic; common roots; 10 percent coarse fragments; medium acid; clear wavy boundary.

Bx1g—12 to 22 inches; olive gray (5Y 5/2) channery silt loam; common medium distinct gray (5Y 5/1), grayish brown (2.5Y 5/2), and brownish yellow (10YR 6/6) mottles; moderate very coarse prismatic structure parting to weak medium subangular blocky; very firm and brittle, slightly sticky and slightly plastic; thin patchy clay films; few roots; 20 percent coarse fragments; medium acid; gradual wavy boundary.

Bx2g—22 to 36 inches; dark grayish brown (2.5Y 4/2) channery silt loam; common medium distinct gray (5Y 5/1) and light olive brown (2.5Y 5/4) mottles; moderate very coarse prismatic structure parting to moderate medium subangular blocky; very firm and brittle, slightly sticky and slightly plastic; thin patchy clay films; 25 percent coarse fragments; slightly acid; gradual wavy boundary.

Bx3g—36 to 40 inches; gray (10YR 5/1) channery silt loam; common fine faint grayish brown (2.5Y 5/2) mottles; moderate very coarse prismatic structure parting to weak thick platy; very firm and brittle, slightly sticky and slightly plastic; 35 percent coarse fragments; slightly acid; gradual wavy boundary.

Cg—40 to 58 inches; gray (10YR 5/1) channery silt loam; common fine faint grayish brown (2.5Y 5/2) and dark brown (10YR 4/3) mottles; weak thick platy structure; firm, slightly sticky and slightly plastic; 40 percent coarse fragments; neutral.

The solum is 40 to 56 inches thick. Depth to bedrock ranges from 40 inches to more than 15 feet. The content of coarse fragments ranges from 0 to 25 percent in the Ap horizon and A2g horizon and from 20 to 45 percent in the Bx horizon and C horizon. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The B horizon is gray (5Y 5/1) to dark grayish brown (10YR 4/2). Fine earth textures are silt loam or loam. The C horizon is neutral to mildly alkaline.

Chippewa soils are near Volusia and Mardin soils. Chippewa soils are wetter than those soils.

CkA—Chippewa silt loam, 0 to 3 percent slopes. This soil is nearly level and is in concave areas at the base of slopes, along drainageways, and in depressions. Areas of this soil are oblong or elongated in shape

and 2 to 50 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thicker and darker and formed, in part, in local alluvium.

Included with this soil in mapping were some small areas of very poorly drained soils and of a soil that is similar to Chippewa silt loam but has no fragipan. These soils are ponded during wet periods, and they have a thick, very dark surface layer that is high in content of organic matter. Also included were some areas of soils that are very strongly acid or strongly acid.

About 75 percent of the acreage has been cleared (fig. 8). A very small acreage is used for crops, and the rest is in pasture. The soil is suited to water-tolerant pasture, grasses, crops, and trees. It is poorly suited to crops and trees. It is poorly suited to crops because it is wet, and local flooding occurs in depressions. Artificial drainage increases the suitability for crops. A high water table and very slow permeability are limitations to most uses. Capability unit IVw–3.

CkB—Chippewa silt loam, 3 to 8 percent slopes. This soil is gently sloping and is in concave areas at the base of slopes and along drainageways and heads of streams. Areas of this soil are irregular in shape and 3 to 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were small areas of nearly level Chippewa soils, a few areas of very stony soils, and some areas of soils that are similar to Chippewa silt loam but are strongly acid or very strongly acid or have no fragipan. Also included were some areas of very poorly drained soils. These soils are ponded during wet periods, and they have a thick, very dark surface layer that is high in content of organic matter.

Most areas of this soil have been cleared and are used for pasture. A small acreage is used for crops. The soil is suited to water-tolerant pasture, grasses, crops, and trees. Wetness makes it poorly suited to crops. Artificial drainage increases the suitability for crops. A high water table and very slow permeability are limitations to most uses. Capability unit IVw–3.

ClB—Chippewa very stony silt loam, 0 to 8 percent slopes. This soil is nearly level and gently sloping and is at the base of slopes, along drainageways, and at the heads of streams. Areas of this soil are irregular in shape and 3 to 150 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thin and in natural sequence rather than plowed. About 5 to 15 percent of the surface is covered by stones and boulders.

Included with this soil in mapping were some areas of very poorly drained soils and of a soil that is similar to the Chippewa soil but has no fragipan. These

Figure 8.—**Typical plant cover on a Chippewa soil after the trees have been cleared.**

areas are ponded during wet periods, and the surface layer is high in content of organic matter.

Some areas of this soil have been cleared and are used for pasture. The soil is too stony to be cultivated. It is best suited to water-tolerant trees and grasses. A high water table and very slow permeability are limitations to most uses. Capability unit VIIs–1.

Clymer Series

The Clymer series consists of deep, well drained soils on the uplands. These soils are gently sloping and are on ridges and mountaintops. They formed in material that weathered from sandstone interbedded with siltstone and shale.

In a representative profile in woodland, about 2 inches of organic material overlies a surface layer of black and light brownish gray channery loam about 3 inches thick. The subsoil is strong brown, yellowish brown, and reddish yellow, friable and firm channery loam and channery clay loam 27 inches thick. The substratum is strong brown very channery sandy loam 15 inches thick. Sandstone bedrock is at a depth of about 45 inches.

The available water capacity is moderate, and permeability is moderate to moderately rapid. The stoniness, coarse fragments, and slope are the main limitations to use.

Representative profile of a Clymer channery loam, 3 to 12 percent slopes, in woodland 3 miles southwest of Blackwell in Morris Township:

O2—2 inches to 0; black (10YR 2/1) partly decomposed organic matter.

A1—0 to 1 inch; black (10YR 2/1) channery loam; weak fine granular structure; very friable, slightly sticky and nonplastic; 15 percent coarse fragments; very strongly acid; abrupt smooth boundary.

A2—1 to 3 inches; light brownish gray (10YR 6/2) channery loam; weak fine granular structure; very friable, slightly sticky and nonplastic; many roots; 15 percent coarse fragments; very strongly acid; abrupt wavy boundary.

B1—3 to 7 inches; strong brown (7.5YR 5/6) channery loam; weak fine and medium subangular blocky structure; friable, slightly sticky and slightly plastic; 15 percent coarse fragments; strongly acid; gradual wavy boundary.

B21t—7 to 16 inches; yellowish brown (10YR 5/8) channery clay loam; moderate fine and medium subangular blocky structure; firm, sticky and plastic; thick patchy clay films on ped faces; common roots; 25 percent coarse fragments; strongly acid; gradual wavy boundary.

B22t—16 to 30 inches; reddish yellow (7/5YR 6/6) channery loam; moderate fine and medium subangular blocky structure; firm, slightly sticky and slightly plastic; thin patchy clay films on ped faces; few roots; 35 percent coarse fragments; strongly acid; gradual wavy boundary.

C—30 to 45 inches; strong brown (7.5YR 5/6) very channery sandy loam; massive, firm, slightly sticky and slightly plastic; 75 percent coarse fragments; strongly acid; clear wavy boundary.

R—45 inches; sandstone bedrock.

The solum is 24 to 40 inches thick. Depth to bedrock is 3½ to 7 feet. The content of coarse fragments of flat angular sandstone ranges from 10 to 20 percent in the A1 horizon, A2 horizon, and B1 horizon; from 10 to 40 percent in the B2 horizon; and from 40 to 75 percent in the C horizon. The A2 horizon ranges from very dark grayish brown (10YR 3/2) to light brownish gray (10YR 6/2). The B horizon ranges from yellowish brown (10YR 5/4) to reddish yellow (7.5YR 6/8).

Clymer soils are near the moderately deep Dekalb soils and the deep Cookport soils. Clymer soils are deeper than Dekalb soils and better drained than Cookport soils.

CmB—Clymer channery loam, 3 to 12 percent slopes. This soil is gently sloping and is on ridgetops and mountaintops. Areas are irregular in shape and about 10 to 300 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were a few small areas of Cookport soils and some areas of very stony Clymer soils and of Dekalb soils. Also included were a few areas of soils that contain more coarse fragments throughout the profile and soils that have less clay in the subsoil.

Most areas of this soil are used for woodland, but the soil is suited to most of the cultivated crops, grasses, and legumes commonly grown in the county. If it is cultivated, erosion control is needed. Coarse fragments and slope are limitations for some uses. Capability unit IIe–1.

CsB—Clymer very stony loam, 3 to 12 percent slopes. This soil is gently sloping and is on ridgetops and mountaintops. Areas are irregular in shape and about 10 to 300 acres in size. The profile of this soil is similar to the one described as representative of the series, but 3 to 15 percent of the surface is covered by stones.

Included with this soil in mapping were a few small areas of Cookport and Dekalb soils. Also included were a few areas of soils that contain more coarse fragments throughout the profile and soils that have less clay in the subsoil.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated, but it can be used for permanent pasture. The stoniness is a limitation for many uses. Capability unit VIs–1.

Cookport Series

The Cookport series consists of deep, moderately well drained soils on the uplands. These soils are nearly level and gently sloping and are on broad ridgetops. They formed in material that weathered from interbedded sandstone, siltstone, and some shale.

In a representative profile 3 inches of organic material overlies a surface layer of dark brown and yellowish brown loam about 6 inches thick. The subsoil extends to a depth of 36 inches. The upper 16 inches is yellowish brown friable clay loam that has many gray and strong brown mottles at a depth of 15 inches; the

lower 14 inches is brown, very firm and brittle clay loam that has many gray and light gray mottles. The substratum is yellowish brown loam 12 inches thick. Sandstone bedrock is at a depth of 48 inches.

The available water capacity is moderate, and permeability is slow. A seasonal high water table is commonly 18 to 36 inches below the surface during wet periods. The slow permeability, seasonal high water table, and stoniness are the main limitations to use.

Representative profile of Cookport loam in an area of Cookport very stony loam, 0 to 8 percent slopes, in a woodlot 3.5 miles southwest of Blackwell in Morris Township:

O1—3 inches to 1 inch; undecomposed leaf litter.

O2—1 inch to 0; black (10YR 2/1) partly decomposed organic matter.

A1—0 to 1 inch; dark brown (10YR 3/3) loam; weak coarse granular structure; very friable; many roots; strongly acid; abrupt wavy boundary.

A2—1 inch to 6 inches; yellowish brown (10YR 5/4) loam; weak fine and medium subangular blocky structure; friable, slightly sticky and nonplastic; common roots; very strong acid; gradual wavy boundary.

B21t—6 to 15 inches; yellowish brown (10YR 5/6) clay loam; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; thin patchy clay films on ped faces; few roots; very strongly acid; clear wavy boundary.

B22t—15 to 22 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct gray (10YR 6/1) and strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; few roots; thin patchy clay films on ped faces; strongly acid; clear wavy boundary.

Bx—22 to 36 inches; brown (7.5YR 4/4) clay loam; many coarse distinct gray (N 6/0) and light gray (10YR 7/2) mottles; very coarse prismatic structure parting to strong coarse subangular blocky; very firm and brittle, sticky and plastic; thin patchy clay films in pores; strongly acid; gradual wavy boundary.

C—36 to 48 inches; yellowish brown (10YR 5/4) loam; common fine distinct light gray (10YR 7/1) mottles; massive; very firm, sticky and plastic; thin patchy clay films in pores; 10 percent coarse fragments; strongly acid; abrupt wavy boundary.

R—48 inches; sandstone bedrock.

The solum is 28 to 40 inches thick. Depth to bedrock ranges from 40 to 50 inches. The content of coarse fragments ranges from 0 to 30 percent in the A horizon and B horizon. These horizons are strong brown (7.5YR 5/6) to dark yellowish brown (10YR 4/4). They are loam to clay loam. The C horizon is dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/4).

Cookport soils are near the moderately deep, well drained Dekalb soils and the deep, well drained Clymer soils. They are deeper than Dekalb soils. They have a Bx horizon and Clymer soils do not.

CvB—Cookport very stony loam, 0 to 8 percent slopes. This soil is nearly level and gently sloping and is on unglaciated mountaintops. Areas of this soil are irregular in shape and 20 to 400 acres in size. About 3 to 15 percent of the surface is covered by stones.

Included with this soil in mapping were a few small areas of Clymer soils and some areas of soils that have a reddish brown subsoil. Also included were some areas of soils near Lycoming County that are similar to the Cookport soil but have mottles at a depth of 6 to 15 inches.

This soil is used for woodland. It is too stony to be cultivated, but it can be used for permanent pasture. The slow permeability, stoniness, and a seasonal high water table are limitations to many uses. Capability unit VIs–1.

Dekalb Series

The Dekalb series consists of moderately deep, well drained soils on the uplands. These soils are gently sloping to very steep and are on ridges, mountaintops, and side slopes. They formed in material that weathered from sandstone and some shale.

In a representative profile in woodland, 2 inches of organic material overlies a surface layer of gray channery sandy loam about 2 inches thick. The subsoil is strong brown and yellowish brown, friable channery loam and channery sandy loam 23 inches thick. The substratum is yellowish brown very channery sandy loam 5 inches thick. Sandstone bedrock is at a depth of about 30 inches.

The available water capacity is low to moderate, and permeability is rapid. The depth to bedrock, slope, and stoniness are the main limitations to use.

Representative profile of Dekalb channery loam, 3 to 12 percent slopes, in a woodlot 3.1 miles east on Mill Run Road from Elk Run Road in Elk Township:

O2—2 inches to 0; black (10YR 2/1) partly decomposed organic matter.

A2—0 to 2 inches; gray (10YR 6/1) channery sandy loam; weak fine granular structure; loose; many roots; 15 percent coarse fragments; strongly acid; clear wavy boundary.

B21ir—2 to 4 inches; strong brown (7.5YR 5/6) channery loam; weak fine subangular blocky structure; very friable; many roots; 15 percent coarse fragments; strongly acid; clear wavy boundary.

B22—4 to 9 inches; yellowish brown (10YR 5/6) channery loam; weak fine and medium subangular blocky structure; friable, slightly sticky and slightly plastic; many roots; 25 percent coarse fragments; strongly acid; gradual wavy boundary.

B23—9 to 25 inches; yellowish brown (10YR 5/8) channery sandy loam; weak fine subangular blocky structure; friable, slightly sticky and slightly plastic; common

roots; 40 percent coarse fragments; strongly acid; gradual wavy boundary.

C—25 to 30 inches; yellowish brown (10YR 5/4) very channery sandy loam; massive; friable; few roots; 80 percent coarse fragments; strongly acid; clear wavy boundary.

R—30 inches; sandstone bedrock.

The solum is 20 to 35 inches thick. Depth to bedrock ranges from 20 to 40 inches. The content of coarse fragments of flat sandstone range from 15 to 40 percent in individual layers of the A horizon and B horizon and from 60 to 80 percent in the C horizon. The B horizon ranges from reddish yellow (7.5YR 6/8) to yellowish brown (10YR 5/4). The C horizon ranges from strong brown (7.5YR 5/6) to yellowish brown (10YR 5/4). Unless limed, the profile is very strongly acid to strongly acid throughout.

Dekalb soils are near Clymer, Cookport, and Lordstown soils. Dekalb soils are not so deep as Clymer soils, and they are better drained than Cookport soils. They contain less silt and more sand than Lordstown soils.

DkB—Dekalb channery loam, 3 to 12 percent slopes. This soil is gently sloping and is on ridgetops and mountaintops. Areas of this soil are irregular in shape and 5 to 150 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were a few small areas of Dekalb extremely stony loams; some areas where bedrock is at a depth of more than 40 inches; and areas of Lordstown and Clymer soils. Also included were a few areas of shallow soils and Rock outcrop.

Most areas of this soil are used for woodland, but the soil is suited to most of the cultivated crops, grasses, and legumes commonly grown in the county. Droughtiness is the main limitation to use for crops. If the soil is cultivated, erosion control is needed. The depth to bedrock is a limitation to most uses. Capability unit IIe–2.

DkC—Dekalb channery loam, 12 to 20 percent slopes. This soil is sloping and is in convex areas on ridges and mountaintops. Areas of this soil are irregular in shape and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but it is shallower to bedrock.

Included with this soil in mapping were some small areas of Dekalb extremely stony loams; areas of a soil that is similar to Dekalb soil but is more than 40 inches deep to bedrock; and areas of Lordstown and Clymer soils. Also included were a few areas of shallow soils similar to this Dekalb soil and Rock outcrop.

Most areas of this soil are used for woodland, but the soil is suited to most of the cultivated crops, grasses, and legumes commonly grown in the county. Droughtiness is the main limitation to use for crops. If the soil is cultivated, erosion control is needed. The depth to bedrock and slope are limitations to most uses. Capability unit IIIe–3.

DsB—Dekalb extremely stony loam, 3 to 12 percent slopes. This soil is gently sloping and is on ridgetops and mountaintops. Areas of this soil are irregular in shape and 10 to 100 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but about 10 to 40 percent of the surface is covered by stones.

Included with this soil in mapping were small areas of soils that are similar but are either shallow or more than 40 inches deep to bedrock; areas of nonstony Dekalb soils; Rock outcrop; and soils that have accumulated organic matter and iron in the upper part of the subsoil. Also included were a few areas of Lordstown and Clymer soils.

This soil is used for woodland. It is too stony to be cultivated or used for pasture. The depth to bedrock and stoniness are limitations to most uses. Capability unit VIIs–2.

DsD—Dekalb extremely stony loam, 12 to 30 percent slopes. This soil is sloping and moderately steep and is on ridges, mountaintops, and side slopes. Areas of this soil are irregular in shape and 5 to 300 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but bedrock is a few inches closer to the surface. About 15 to 40 percent of the surface is covered by stones.

Included with this soil in mapping were some areas of soils that are similar but either shallow or more than 40 inches deep to bedrock; nonstony Dekalb soils; Rock outcrop; and soils that have accumulated organic matter and iron in the upper part of the subsoil. Also included were some areas of Lordstown and Clymer soils.

This soil is used for woodland. It is too stony to be cultivated or to be used for pasture. The depth to bedrock, stoniness, and slope are limitations to most uses. Capability unit VIIs–2.

DsF—Dekalb extremely stony loam, 30 to 70 percent slopes. This soil is steep and very steep and is on sides of ridges and valley walls. Areas are irregular in shape and 10 to 500 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but bedrock is nearer the surface. About 20 to 50 percent of the surface is covered by stones, and rock outcrop is common.

Included with this soil in mapping were some areas of soils that are similar but less than 20 inches or more than 40 inches deep to bedrock. Also included were some areas of Lordstown and Oquaga soils.

This soil is used for woodland. It is too stony and steep to be cultivated or to be used for pasture. The depth to bedrock, slope, and stoniness are limitations to most uses. Capability unit VIIs–3.

Kanona Series

The Kanona series consists of deep, poorly drained to somewhat poorly drained soils on the uplands. These soils are gently sloping to moderately steep and are on hilltops and side slopes. They formed in glacial till derived from shale and siltstone.

In a representative profile in a cultivated field the surface layer is dark brown silt loam about 7 inches thick. The subsoil is light brownish gray, firm silty clay loam and silty clay 18 inches thick. It has many yellowish brown, strong brown, brown, dark brown, and gray mottles. The substratum is yellowish brown, and dark yellowish brown shaly and very shaly silty clay loam 23 inches thick. Shale bedrock is at a depth of 48 inches.

The available water capacity is moderate, and permeability is slow. A high water table is at or within 18 inches of the surface during wet periods. The slow permeability and high water table are the main limitations to use.

Representative profile of Kanona silt loam, 3 to 8 percent slopes, in a cultivated field 2.6 miles south of Wellsboro in Delmar Township (Sample numbers BK–15435 in test data table) :

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam; weak medium granular structure; friable, slightly sticky and slightly plastic; many roots; 10 percent coarse fragments; medium acid; abrupt wavy boundary.

B21g—7 to 16 inches; light brownish gray (2.5Y 6/2) silty clay loam; many fine distinct yellowish brown (10YR 5/8) and strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; firm, sticky and plastic; common roots; few thin clay films and black stains; 10 percent coarse fragments; strongly acid; gradual wavy boundary.

B22g—16 to 25 inches; light brownish gray (10YR 6/2) silty clay; many medium distinct gray (10YR 6/1), brown (10YR 5/3), and dark brown (7.5YR 4/4) mottles; moderate coarse prismatic structure parting to moderate thick platy and moderate coarse angular blocky; firm; sticky and plastic; few roots; few thin clay films and black stains; 10 percent coarse fragments; strongly acid; gradual wavy boundary.

C1—25 to 42 inches; yellowish brown (10YR 5/4) shaly silty clay loam; common fine distinct gray (10YR 6/1) and strong brown (7.5YR 5/6) mottles; moderate thick platy structure; firm, sticky and plastic; few thin clay films on ped faces; common black coatings and stains; 15 percent coarse fragments; medium acid; clear wavy boundary.

C2—42 to 48 inches; dark yellowish brown (10YR 4/4) very shaly silty clay loam; common fine distinct grayish brown (10 YR 5/2) and strong brown (7.5YR 5/6) mottles; massive; firm, sticky and plastic; common black stains; 50 percent coarse fragments; medium acid; clear wavy boundary.

R—48 inches; shale bedrock.

The solum is 20 to 40 inches thick. Depth to bedrock ranges from 40 to 60 inches. The content of coarse fragments, mainly shale, ranges from 5 to 15 percent in the A horizon and B horizon and from 15 to 50 percent in the C horizon. The A horizon and B horizon are strongly acid to medium acid, and the C horizon is medium acid to slightly acid. The Ap horizon is dark brown (10YR 4/3) or dark grayish brown (10YR 4/2) silt loam to silty clay loam. The B horizon is grayish brown (10YR 5/2) or light brownish gray (10YR 6/2). It ranges from prismatic to blocky in structure.

Kanona soils are near Mardin, Volusia, and Chippewa soils. Kanona soils contain more clay and lack the Bx horizon of those soils.

KaB—Kanona silt loam, 3 to 8 percent slopes. This soil is gently sloping and is on hilltops. Areas are irregular in shape and 3 to 75 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were small areas of nearly level Kanona soils and a few small areas of soils that are similar to this Kanona soil but that are moderately deep and moderately well drained. Also included were some small areas of gently sloping Volusia soils.

Most areas of this soil have been cleared and are used for crops. The soil is suited to limited cultivation, to hay, and to pasture. Artificial drainage increases its suitability for crops. A seasonal high water table and slow permeability are limitations to most uses. Capability unit IVw–2.

KaC—Kanona silt loam, 8 to 15 percent slopes. This soil is sloping and is on hilltops and side slopes. Areas are irregular in shape and 3 to 50 acres or more in size.

Included with this soil in mapping were some small areas of gently sloping and moderately steep Kanona soils and some areas of soils that are similar to this Kanona soil but that are moderately deep and moderately well drained. Also included were some small areas of sloping Volusia soils.

Most areas of this soil have been cleared and are used for crops or pasture. The soil is suited to limited cultivation, to hay, and to pasture. Artificial drainage increases its suitability for crops. A seasonal high water table, slow permeability, and slope are limitations to most uses. Capability unit IVw–2.

KcD3—Kanona silty clay loam, 15 to 25 percent slopes, eroded. This soil is moderately steep and is on side slopes. Areas are oblong and irregular in shape and 3 to 40 acres or more in size. Nearly all of the original surface layer is missing because of erosion.

Included with this soil in mapping were some small areas of soils that are similar to this Kanona soil but are moderately deep and moderately well drained. Also included were small areas of moderately steep Volusia and Mardin soils.

Most areas of this soil have been cleared and are used for pasture. The soil is not suited to cultivation, but it is suited to permanent pasture, woodland, or wildlife habitat. A seasonal high water table, slow permeability, slope, and erosion hazard are limitations to most uses. Capability unit VIe–1.

Lackawanna Series

The Lackawanna series consists of deep, well drained soils on the uplands. These soils are gently sloping and sloping and are on convex side slopes and hilltops. They formed in glacial till derived from mixed red and brown sandstone, siltstone, and shale.

In a representative profile in a cultivated area the surface layer is dark reddish brown channery loam about 8 inches thick. The subsoil extends to a depth of 44 inches. The upper 22 inches is reddish brown, friable and firm channery loam and gravelly loam; and the lower 14 inches is weak red, very firm and brittle

gravelly loam. The substratum is weak red gravelly loam to a depth of 68 inches.

The available water capacity is moderate, and permeability is slow. The slow permeability and slope are the main limitations to use.

Representative profile of Lackawanna channery loam, 3 to 12 percent slopes, in a cultivated field 0.75 mile northeast of Liberty in Liberty Township:

Ap—0 to 8 inches; dark reddish brown (5YR 3/4) channery loam; weak fine granular structure; very friable, nonsticky and slightly plastic; many roots; 15 percent coarse fragments; neutral; abrupt wavy boundary.

B21—8 to 13 inches; reddish brown (2.5YR 4/4) channery loam; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; common roots; 25 percent coarse fragments; neutral; gradual wavy boundary.

B22—13 to 30 inches; reddish brown (2.5YR 4/4) gravelly loam; moderate medium subangular blocky structure; firm, slightly sticky and slightly plastic; common roots; thin patchy clay films in pores; 30 percent coarse fragments; very strongly acid; gradual wavy boundary.

Bxl—30 to 38 inches; weak red (2.5YR 4/2) gravelly loam; moderate coarse prismatic structure parting to moderate coarse subangular blocky; very firm and brittle, sticky and plastic; thick patchy clay films in pores; 40 percent coarse fragments; very strongly acid; gradual wavy boundary.

Bx2—38 to 44 inches; weak red (10R 4/4) gravelly loam; weak very coarse prismatic structure parting to weak thick platy; very firm and brittle, sticky and slightly plastic; thin patchy clay films in cracks and pores; 40 percent coarse fragments; very strongly acid; gradual wavy boundary.

C—44 to 68 inches; weak red (10R 4/3) gravelly loam; massive; friable, slightly sticky and slightly plastic; thin patchy clay films in pores; 20 percent coarse fragments; very strongly acid.

The solum is 40 to 60 inches thick. Depth to bedrock ranges from 40 inches to many feet. Depth to the fragipan is 24 to 36 inches. The content of coarse fragments of flat, angular, or rounded sandstone, siltstone, or shale range from 15 to 35 percent in the A horizon and B2 horizon and from 20 to 50 percent in the Bx horizon and C horizon. The Ap horizon ranges from dark reddish brown (5YR 3/4) to dark brown (7.5YR 4/2). The B2 horizon ranges from strong brown (7.5YR 5/6) to reddish brown (2.5YR 4/4), and the fine earth part ranges from silt loam to loam. The Bx horizon ranges from reddish brown (5YR 5/4) to weak red (2.5YR 4/2), and the fine earth part ranges from silt loam to heavy loam. Unless limed, the soil is very strongly acid to strongly acid in the B2 horizon and very strongly acid to medium acid in the Bx horizon and C horizon. The C horizon is similar in color and texture to the Bx horizon.

Lackawanna soils are near the moderately deep Oquaga soils and the deep Wellsboro, Morris, and Norwich soils. Lackawanna soils are better drained than Wellsboro, Morris, and Norwich soils.

LaB—Lackawanna channery loam, 3 to 12 percent slopes. This soil is gently sloping and is on hilltops. Areas of this soil are oblong and elongated in shape and 5 to 100 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were a few small areas of nearly level Lackawanna soils and some areas of nearly level and gently sloping Oquaga and Wellsboro soils.

Most areas of this soil have been cleared and are used for crops. The soil is suited to most of the cultivated crops commonly grown in the county and to woodland and wildlife habitat. The slow permeability is a limitation to some uses. Capability unit IIe–1.

LaC—Lackawanna channery loam, 12 to 20 percent slopes. This soil is sloping and is on hilltops and side slopes. Areas of this soil are irregular in shape and 3 to 75 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the fragipan is a few inches deeper.

Included with this soil in mapping were some small areas of Wellsboro and Oquaga soils and a few areas of gently sloping and moderately steep Lackawanna soils.

Most areas of this soil have been cleared and are used for crops. The soil is suited to most of the cultivated crops commonly grown in the county and to woodland and wildlife habitat. If it is cultivated, erosion control is needed. The slow permeability and slope are limitations to many uses. Capability unit IIIe–1.

Lordstown Series

The Lordstown series consists of moderately deep, well drained soils on the uplands. These soils are gently sloping to very steep and are on side slopes, benches, ridges, and mountaintops. They formed in glacial till derived from gray and brown sandstone, siltstone, and shale.

In a representative profile in woodland, 1 inch of organic material overlies a surface layer of very dark brown and pale brown channery loam about 7 inches thick. The subsoil is yellowish brown, friable channery loam 25 inches thick. The substratum is brown channery loam 25 inches thick. The substratum is brown channery loam 6 inches thick. Sandstone bedrock is at a depth of about 38 inches.

The available water capacity is moderate to low, and permeability is moderate. The depth to bedrock, slope, or stoniness are limitations to most uses.

Representative profile of Lordstown channery loam in an area of Lordstown very stony loam, 12 to 30 percent slopes, in a woodlot 3 miles northwest of Asaph in Shippen Township (Sample numbers BK–34573 and BK–34574 in test data table):

O2—1 inch to 0; black (10YR 2/1) partly decomposed organic matter.

A1—0 to 2 inches; very dark brown (10YR 2/2) channery loam; weak fine granular structure; very friable; many roots; 20 percent coarse fragments; extremely acid; clear wavy boundary.

A2—2 to 7 inches; pale brown (10YR 6/3) channery loam; weak fine granular and weak thin platy structure; very friable; many roots; 25 percent coarse fragments; strongly acid; clear wavy boundary.

B21—7 to 13 inches; yellowish brown (10YR 5/4) channery loam; weak very fine subangular blocky structure; friable; many roots; 30 percent coarse fragments; strongly acid; clear wavy boundary.

B22—13 to 32 inches; yellowish brown (10YR 5/4) channery loam; weak fine subangular blocky structure; friable, common roots; 40 percent coarse fragments; strongly acid; gradual wavy boundary.

C—32 to 38 inches; brown (10YR 5/3) channery loam; massive; friable, slightly sticky and slightly plastic; few roots; 40 percent coarse fragments; strongly acid; clear wavy boundary.

R—38 inches; sandstone bedrock.

The solum is 20 to 36 inches thick. Depth to bedrock is 20 to 40 inches. The content of coarse fragments, mainly flat angular sandstone, ranges from 15 to 30 percent in the A horizon, from 20 to 50 percent in the B horizon, and from 35 to 70 percent in the C horizon. Coarse fragments average 35 to 45 percent from a depth of 10 inches to bedrock. The A horizon ranges from grayish brown (10YR 5/2) to very dark brown (10YR 2/2). The B horizon ranges from brown (10YR 5/3) to yellowish brown (10YR 5/6). It is strongly acid or very strongly acid. The fine earth part ranges from loam to silt loam. The C horizon ranges from grayish brown (10YR 4/2) to brown (10YR 5/3) and in places has a few high-chroma mottles immediately above the bedrock.

Lordstown soils in Tioga County contain more coarse fragments than is defined as the range for the series. This difference, however, does not alter their use, management, or behavior.

Lordstown soils are near Bath, Mardin, Volusia, and Chippewa soils. Lordstown soils are not so deep as those soils. Lordstown soils are deeper than the associated Arnot soils, which are less than 20 inches deep to bedrock.

LoB—Lordstown channery loam, 3 to 12 percent slopes. This soil is gently sloping and is on benches and mountaintops. Areas are irregular in shape and 3 to 200 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but in most places the surface layer is plowed.

Included with this soil in mapping were some small areas of nearly level Lordstown and Bath soils and very stony soils. Also included were some areas of a soil that is similar to this Lordstown soil but that is more than 40 inches deep to bedrock, areas of Rock outcrop, and Arnot soils.

Most areas of this soil have been cleared and are used for crops. The soil is droughty, but it is suited to most cultivated crops, grasses, and legumes commonly grown in the county. It is also suited to woodland and wildlife habitat. If the soil is cultivated, erosion control is needed. The depth to bedrock is a limitation to most uses. Capability unit IIe–2.

LoC—Lordstown channery loam, 12 to 20 percent slopes. This soil is sloping and is mainly on side slopes, ridges, and mountaintops. Areas are oblong and irregular in shape and 3 to 150 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but in most places the surface layer is plowed.

Included with this soil in mapping were some areas of gently sloping and moderately steep Lordstown soils and some small areas of very stony soils. Also included were some areas of soils that are similar to this Lordstown soil but that are more than 40 inches deep to bedrock, areas of Rock outcrop, and Arnot soils.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is droughty, but it is suited to most of the cultivated crops, grasses, and legumes commonly grown in the county. It is also suited to woodland and wildlife habitat. If the soil is cultivated, erosion control is needed. The depth to bedrock and slope are limitations to most uses. Capability unit IIIe–3.

LoD—Lordstown channery loam, 20 to 30 percent slopes. This soil is moderately steep and is mainly on side slopes and ridges. Areas are oblong and irregular in shape and 3 to 100 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but in most places the surface layer is plowed.

Included with this soil in mapping were some small areas of very stony and steep Lordstown soils and some areas of soils that are similar to this Lordstown soil but that are more than 40 inches deep to bedrock. Also included were some areas of Rock outcrop and Arnot soils.

Most areas of this soil have been cleared and are used for crops or pasture, or they are idle. The soil is droughty, but it is suited to limited cultivation, to hay, and to pasture. It is also suited to woodland and wildlife habitat. If the soil is cultivated, erosion control is needed. The depth to bedrock and slope are limitations to most uses. Capability unit IVe–3.

LsB—Lordstown very stony loam, 3 to 12 percent slopes. This soil is gently sloping and is on benches, ridges, and mountaintops. Areas are irregular in shape and 3 to 200 acres or more in size. The profile of this soil is similar to the one described as representative of the series but the surface layer is slightly thicker. About 5 to 15 percent of the surface is covered by stones.

Included with this soil in mapping were some small areas of very stony Bath and Mardin soils and some areas of soils that are similar to this Lordstown soil but that are more than 40 inches deep to bedrock. Also included were some areas of Rock outcrop and Arnot soils.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated, but it is suited to

pasture. The depth to bedrock and stoniness are limitations to most uses. Capability unit VIs–1.

LsD—Lordstown very stony loam, 12 to 30 percent slopes. This soil is sloping and moderately steep and is on side slopes and ridges. Areas are irregular in shape and 3 to 150 acres or more in size. This soil has the profile described as representative of the series. About 5 to 25 percent of the surface is covered by stones and boulders.

Included with this soil in mapping were some small areas of gently sloping and steep Lordstown, Bath, and Mardin soils and some areas of soils that are similar to this Lordstown soil but that are more than 40 inches deep to bedrock. Also included were some areas of Rock outcrop and Arnot soils.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated, but it is suited to pasture. The depth to bedrock, stoniness, and slope are limitations to most uses. Capability unit VIs–1.

Mardin Series

The Mardin series consists of deep, moderately well drained soils on the uplands. These soils are nearly level to moderately steep and are on side slopes, hills, and mountaintops. They formed in glacial till derived from gray and brown sandstone, siltstone, and shale.

In a representative profile in a cultivated field, the surface layer is dark brown channery silt loam about 7 inches thick. The subsoil extends to a depth of 58 inches. The upper 17 inches is yellowish brown and light olive brown, friable and firm channery silt loam that has common gray and yellowish brown mottles at a depth of 19 inches. The lower 34 inches is dark brown and olive brown, very firm and brittle very channery loam and very channery silt loam that has gray and strong brown mottles. The substratum is olive very channery silt loam to a depth of 75 inches.

The available water capacity is moderate, and permeability is slow. A seasonal high water table rises to within 18 to 36 inches of the surface during wet periods. The slow permeability, seasonal high water table, slope, and stoniness are the main limitations to use.

Representative profile of Mardin channery silt loam, 3 to 8 percent slopes, in a cultivated field 5 miles northeast of Williamson School in Jackson Township:

Ap—0 to 7 inches; dark brown (10YR 3/3) channery silt loam; weak fine granular structure; very friable, nonsticky and nonplastic; many roots; 20 percent coarse fragments; slightly acid; abrupt wavy boundary.

B21—7 to 12 inches; yellowish brown (10YR 5/6) channery silt loam; weak fine subangular blocky structure; friable, slightly sticky and nonplastic; common roots; 20 percent coarse fragments; strongly acid; gradual wavy boundary.

B22—12 to 19 inches; light olive brown (2.5Y 5/4) channery silt loam; weak fine and medium subangular blocky structure; friable, slightly sticky and nonplastic; common roots; 20 percent coarse fragments; medium acid; gradual wavy boundary.

B23—19 to 24 inches; light olive brown (2.5Y 5/4) channery silt loam; common fine distinct gray (N 6/0) and yellowish brown (10YR 5/8) mottles; moderate fine and medium subangular blocky structure; firm, slightly sticky and nonplastic; few roots; 30 percent coarse fragments; strongly acid; gradual wavy boundary.

Bx1—24 to 40 inches; dark brown (10YR 4/3) very channery loam; many medium distinct gray (N 6/0) and strong brown (7.5YR 5/8) mottles; moderate very coarse prismatic structure parting to moderate medium subangular blocky; very firm and brittle, slightly sticky and slightly plastic; thin patchy clay films in pores; 50 percent coarse fragments; medium acid; gradual wavy boundary.

Bx2—40 to 58 inches; olive brown (2.5Y 4/4) very channery silt loam; common fine distinct gray (N 6/0) and yellowish brown (10YR 5/8) mottles; moderate very coarse prismatic structure parting to moderate medium and coarse subangular blocky; very firm and brittle, slightly sticky and slightly plastic; thin patchy clay films in pores; 50 percent coarse fragments; medium acid; gradual wavy boundary.

C—58 to 75 inches; olive (5Y 4/4) very channery silt loam; massive; very firm, slightly sticky and slightly plastic; 50 percent coarse fragments; slightly acid.

The solum is 40 to 60 inches thick. Depth to bedrock is more than 60 inches. Depth to the fragipan is 14 to 26 inches. The content of coarse fragments ranges from 15 to 30 percent in the A horizon and B2 horizon and from 20 to 60 percent in the Bx horizon and C horizon. The Ap horizon ranges from very dark grayish brown (10YR 3/2) to brown (10YR 5/3). It is slightly acid or neutral in places. The A horizon and B2 horizon are mainly very strongly acid to medium acid. The fine earth part of the B2 horizon ranges from loam to silt loam. The Bx horizon ranges from dark brown (10YR 4/3) to olive (5Y 4/4).

Mardin soils are near the well drained Bath and Lordstown soils, the somewhat poorly drained Volusia soils, and the poorly drained Chippewa soils.

MaA—Mardin channery silt loam, 0 to 3 percent slopes. This soil is nearly level and is on hills and mountaintops. Areas are irregular in shape and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the mottles and the fragipan are a few inches closer to the surface.

Included with this soil in mapping were some small areas of gently sloping Mardin soils, nearly level Volusia soils, and Lordstown and Bath soils. Also included were some areas of soils that are similar to this Mardin soil but that are slightly acid or neutral in the subsoil.

Most areas of this soil have been cleared and are used for crops. The soil is suited to most of the cultivated crops, grasses, and legumes commonly grown in the county. Artificial drainage increases its suitability for crops. A seasonal high water table and slow permeability are limitations to most uses. Capability unit IIw–2.

MaB—Mardin channery silt loam, 3 to 8 percent slopes. This soil is gently sloping and is on hills and mountaintops. Areas are irregular in shape and 3 to 50 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were some small areas of nearly level and sloping Mardin soils and very stony soils and a few small areas of Lordstown, Bath, and Volusia soils. Also included were some areas of soils that are similar to the Mardin soil but that are slightly acid or neutral in the subsoil.

Most areas of this soil have been cleared and are used for crops. The soil is suited to most of the cultivated crops, grasses, and legumes grown in the county. Artificial drainage increases its suitability for crops. A seasonal high water table and slow permeability are limitations to most uses. Capability unit IIw–2.

MaC—Mardin channery silt loam, 8 to 15 percent slopes. This soil is sloping and is on side slopes and hills. Areas are oblong or irregular in shape and 3 to 100 acres or more in size.

Included with this soil in mapping were some small areas of gently sloping and moderately steep Mardin soils and stony soils and a few areas of Lordstown, Bath, and Volusia soils. Also included were some areas of a soil that is similar to the Mardin soil but that is slightly acid or neutral in the subsoil.

Most areas of this soil have been cleared and are used for crops or pasture. The soil is suited to most of the cultivated crops, grasses, and legumes grown in the county. If it is cultivated, erosion control is needed. A seasonal high water table, slow permeability, and slope are limitations to most uses. Capability unit IIIe–2.

MaD—Mardin channery silt loam, 15 to 25 percent slopes. This soil is moderately steep and is on side slopes of hills and mountains. Areas are oblong and irregular in shape and 3 to 125 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is slightly thinner.

Included with this soil in mapping were some small areas of sloping and steep Mardin soils and a few small areas of very stony soils and Lordstown and Bath soils. Also included were some areas of soils that are similar to this Mardin soil but that are slightly acid or neutral in the subsoil.

Most areas of this soil have been cleared and are used for crops and pasture, or they are idle. The soil is suited to limited cultivation, to hay, and to pasture. If it is cultivated, erosion control is needed. A seasonal high water table, slow permeability, and slope are limitations to most uses. Capability unit IVe–2.

MdB—Mardin very stony silt loam, 0 to 8 percent slopes. This soil is nearly level to gently sloping and is mainly on mountaintops. Areas are irregular in shape and 3 to 200 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thin and is not plowed. About 5 to 15 percent of the surface is covered by stones.

Included with this soil in mapping were some small areas of very stony Bath and Volusia soils and some areas of a soil that is similar to this Mardin soil but that is slightly acid or neutral in the subsoil.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated, but it can be used for pasture if it has been cleared of trees. A seasonal high water table, slow permeability, and stoniness are limitations to most uses. Capability unit VIs–1.

MdD—Mardin very stony silt loam, 8 to 25 percent slopes. This soil is sloping and moderately steep and is on the sides of hills and mountains. Areas are irregular in shape and 3 to 175 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thin and is not plowed. About 5 to 25 percent of the surface is covered by stones and boulders.

Included with this soil in mapping were some small areas of gently sloping and steep, very stony Volusia soils and some areas of soils that are similar to this Mardin soil but that are slightly acid or neutral in the subsoil.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated, but it can be used for pasture. A seasonal high water table, slow permeability, stoniness, and slope are limitations to most uses. Capability unit VIs–1.

Morris Series

The Morris series consists of deep, somewhat poorly drained soils on the uplands. These soils are nearly level to moderately steep. They formed in glacial till derived from mixed red and brown sandstone, siltstone, and shale. Slopes are uniform to slightly convex.

In a representative profile in a cultivated field, the surface layer is dark reddish brown gravelly silt loam about 8 inches thick. The subsoil extends to a depth of 48 inches. The upper 12 inches is reddish brown and reddish gray, friable gravelly silt loam that has gray and light brown mottles at a depth of 13 inches. The lower 28 inches is weak red, very firm and brittle gravelly loam that has many gray, reddish gray, and reddish brown mottles. The substratum is weak red gravelly loam to a depth of 56 inches.

The available water capacity is moderate, and permeability is slow. A seasonal high water table rises to within 6 to 18 inches of the surface during wet periods. The seasonal high water table, slow permeability, and stoniness are the main limitations to use.

Representative profile of Morris gravelly silt loam, 3 to 8 percent slopes, in a cultivated field 7 miles northeast of State Road Church in Sullivan Township (Sample numbers BK–33254 and BK–33255 in test data table) :

Ap—0 to 8 inches; dark reddish brown (5YR 3/2) gravelly silt loam; weak fine granular structure; very friable, slightly sticky and slightly plastic; many roots;

15 percent coarse fragments; medium acid; abrupt wavy boundary.

B21—8 to 13 inches; reddish brown (5YR 4/3) gravelly silt loam; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; common roots; 15 percent coarse fragments; strongly acid; clear wavy boundary.

B22—13 to 20 inches; reddish gray (5YR 5/2) gravelly silt loam; common medium distinct gray (N 5/0) and light brown (7.5YR 6/4) mottles; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; few roots; 15 percent coarse fragments; strongly acid; clear wavy boundary.

Bx1—20 to 36 inches; weak red (2.5YR 4/2) gravelly loam; many medium distinct gray (5YR 5/1) and reddish brown (5YR 5/4) mottles; moderate very coarse prismatic structure parting to moderate medium subangular blocky; very firm and brittle, slightly sticky and slightly plastic; thin patchy clay films; 15 percent coarse fragments; strongly acid; clear wavy boundary.

Bx2—36 to 48 inches; weak red (2.5YR 5/2) gravelly loam; many coarse distinct gray (N 6/0) and reddish gray (5YR 5/2) mottles; moderate very coarse prismatic structure parting to weak thick platy; very firm and brittle, slightly sticky and slightly plastic; thin patchy clay films; 15 percent coarse fragments; strongly acid; gradual wavy boundary.

C—48 to 56 inches; weak red (2.5YR 4/2) gravelly loam; many coarse distinct gray (N 6/0) and reddish brown (5YR 5/4) mottles; massive; firm, slightly sticky and slightly plastic; 25 percent coarse fragments; strongly acid.

The solum is 40 to 60 inches thick. Depth to bedrock ranges from 40 inches to more than 6 feet. Depth to the fragipan is 12 to 22 inches. The content of coarse fragments ranges from 10 to 40 percent in the A horizon and B horizon and 15 to 45 percent in the Bx horizon and C horizon. The Ap horizon ranges from dark reddish brown (5YR 3/2) to dark yellowish brown (10YR 4/4). The B2 horizon ranges from reddish brown (5YR 4/3) to brown (7.5YR 5/4), and the fine earth part ranges from loam to silt loam. The Bx horizon ranges from weak red (2.5YR 4/2) to strong brown (7.5YR 5/6), and has high- and low-chroma mottles. The fine earth part ranges from loam to silty clay loam. The C horizon is similar in color and texture to the Bx horizon.

Morris soils are near the well drained Lackawanna soils, the moderately well drained Wellsboro soils, and the very poorly drained Norwich soils. Morris soils are wetter than Lackawanna and Wellsboro soils, and they are better drained than Norwich soils.

MoA—Morris gravelly silt loam, 0 to 3 percent slopes. This soil is nearly level and is on the lower slopes and tops of mountains. Areas are irregular in shape and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the fragipan and mottles are slightly closer to the surface.

Included with this soil in mapping were some small areas of Norwich soils and gently sloping Morris and Wellsboro soils.

Most areas of this soil have been cleared and are used for cultivated crops and grasses. Artificial drainage increases its suitability for crops. Alfalfa and winter grain are subject to frost-heave damage. A seasonal high water table and slow permeability are limitations to most uses. Capability unit IIIw–3.

MoB—Morris gravelly silt loam, 3 to 8 percent slopes. This soil is gently sloping and is on uniform or slightly concave lower slopes and mountaintops. Areas are irregular in shape and 3 to 75 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were some small areas of nearly level and sloping Morris soils, a few areas of very stony soils, and a few small areas of Wellsboro soils.

Most areas of this soil have been cleared and are used for crops or pasture. The soil is suited to most cultivated crops and grasses. Artificial drainage increases its suitability for crops. Alfalfa and winter grain are subject to frost-heave damage. A seasonal high water table and slow permeability are limitations to most uses. Capability unit IIIw–3.

MoC—Morris gravelly silt loam, 8 to 15 percent slopes. This soil is sloping and is in uniform or slightly concave areas of lower slopes and tops of mountains. Areas are oblong and irregular in shape and 3 to 100 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the fragipan is slightly deeper.

Included with this soil in mapping were some small areas of gently sloping and moderately steep Morris and Wellsboro soils and very stony soils.

Most areas of this soil have been cleared and are used for cultivated crops and pasture. Alfalfa and winter grain are subject to frost-heave damage. If the soil is cultivated, erosion control is needed. A seasonal high water table, slow permeability, and slope are limitations to most uses. Capability unit IIIe–4.

MoD—Morris gravelly silt loam, 15 to 25 percent slopes. This soil is moderately steep and is on hillsides. Areas are long, narrow, and irregular in shape and 3 to 75 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the fragipan is slightly deeper.

Included with this soil in mapping were small areas of sloping Morris soils and moderately steep and stony Wellsboro and Oquaga soils.

Most areas of this soil have been cleared and are used for crops. The soil is suited to hay, to pasture, and to limited cultivation. If it is cultivated, erosion control is needed. A seasonal high water table, slow permeability, and slope are limitations to most uses. Capability unit IVe–4.

MsB—Morris very stony silt loam, 0 to 8 percent slopes. This soil is nearly level and gently sloping and is in uniform or slightly concave areas on lower slopes and mountaintops. Areas are oblong and irregular in shape and 3 to 200 acres or more in size. The profile of

this soil is similar to the one described as representative of the series, but the surface layer is thin and is not plowed. About 5 to 15 percent of the surface is covered by stones and boulders.

Included with this soil in mapping were some small areas of nearly level and gently sloping Norwich, Wellsboro, and Lackawanna soils.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated or to be used for pasture. It is best suited to woodland or wildlife habitat. A seasonal high water table, slow permeability, and stoniness are limitations to most uses. Capability unit VIIs–1.

MsD—Morris very stony silt loam, 8 to 25 percent slopes. This soil is sloping and moderately steep and is on lower slopes and hillsides. Areas are long, narrow, and irregular in shape and 3 to 175 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thin and is not plowed. About 5 to 25 percent of the surface is covered by stones and boulders.

Included with this soil in mapping were some small areas of Wellsboro and Oquaga soils.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated or to be used for pasture. It is best suited to woodland or wildlife habitat. A seasonal high water table, slow permeability, slope, and stoniness are limitations to most uses. Capability unit VIIs–1.

Norwich Series

The Norwich series consists of deep, very poorly drained soils on the uplands. These soils are nearly level and are in slight depressions. They formed in glacial till derived from red and brown sandstone, siltstone, and shale and local alluvium.

In a representative profile 6 inches of organic material overlies a surface layer of gray silt loam about 4 inches thick. The subsoil extends to a depth of 36 inches. The upper 18 inches is grayish brown and gray, firm silt loam and loam and has gray, brownish yellow, and yellowish brown mottles. The lower 14 inches is weak red, very firm and brittle gravelly silty clay loam and has many red mottles. The substratum is weak red gravelly silty clay loam to a depth of 58 inches.

The available water capacity is moderate, and permeability is very slow. A high water table is at or near the surface during wet periods. The high water table, very slow permeability, and stoniness are the main limitations to use.

Representative profile of Norwich silt loam in a woodlot 300 feet west of Liberty High School and 1,300 feet south of Route 414 in Liberty Township:

O1—6 to 5 inches; undecomposed leaf litter and sphagnum moss.

O2—5 inches to 0; black (10YR 2/1) partly decomposed organic matter.

A2g—0 to 4 inches; gray (10YR 5/1) silt loam; weak fine and medium subangular blocky structure; friable; common roots; strongly acid; gradual wavy boundary.

B21g—4 to 9 inches; grayish brown (10YR 5/2) silt loam; many fine distinct gray (10YR 6/1) and brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; firm; few roots; strongly acid; gradual wavy boundary.

B22g—9 to 22 inches; gray (10YR 5/1) loam; common fine faint gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; strong coarse subangular blocky structure; firm, slightly sticky and slightly plastic; few roots; few thin clay films; strongly acid; gradual wavy boundary.

IIBxg—22 to 36 inches; weak red (2.5YR 4/2) gravelly silty clay loam; common fine faint red (2.5YR 5/6) mottles; weak very coarse prismatic structure parting to strong coarse subangular blocky; very firm and brittle, slightly sticky and slightly plastic; few thin clay films; 20 percent coarse fragments; slightly acid; gradual wavy boundary.

IICg—36 to 58 inches; weak red (2.5YR 4/2) gravelly silty clay loam; massive; firm, sticky and plastic; 35 percent coarse fragments; neutral.

The solum is 36 to 50 inches thick. Depth to bedrock is more than 40 inches. Depth to the fragipan is 10 to 24 inches. The content of coarse fragments is as high as 20 percent in the A horizon and B2 horizon and is 10 to 40 percent in the Bx horizon and C horizon. The profile ranges from strongly acid to slightly acid in individual layers of the A horizon and B horizon and from strongly acid to neutral in the C horizon. The Bg horizon ranges from pale red (2.5YR 6/2) to dark gray (10YR 4/1) and has higher chroma mottles. The Bx horizon ranges from dark reddish gray (5YR 4/2) to brown (10YR 5/3) and has high-chroma mottles.

Norwich soils are near the well drained Lackawanna and Oquaga soils, the moderately well drained Wellsboro soils, and the somewhat poorly drained Morris soils. Norwich soils are wetter than those soils.

No—Norwich silt loam. This soil is nearly level and is at the base of side slopes, along drainageways, in depressions, and adjacent to seep spots. The slope is 0 to 5 percent. Areas are round, oblong, or irregular in shape and 3 to 50 acres or more in size. This soil has the profile described as representative of the series.

Included in mapping were a few areas of nearly level Morris soils and a few small areas of very stony soils.

Most areas of this soil are in woodland, but a few areas are in pasture. Because of wetness the soil is poorly suited to cultivation. It is suited to water-tolerant grasses and crops and to woodland and wildlife habitat. Artificial drainage increases its suitability for crops. A high water table and very slow permeability are limitations to most uses. Capability unit IVw–3.

Ns—Norwich very stony silt loam. This soil is nearly level and is at the base of side slopes, along drainageways, in depressions, and adjacent to seep spots. The slope is 0 to 5 percent. Areas are round, oblong, or irregular in shape and 3 to 50 acres or more in size. About 5 to 15 percent of the surface is covered by stones and boulders.

Included in mapping were small areas of very stony Morris soils.

Most areas of this soil are in woodland. The soil is too stony and wet to be cultivated or to be used for pasture. It is best suited to woodland and wildlife habitat. The wetness, very slow permeability, and stoniness are limitations to most uses. Capability unit VIIs–1.

Oquaga Series

The Oquaga series consists of moderately deep, well drained soils on the uplands. These soils are gently sloping to very steep and are on side slopes and hilltops. They formed in glacial till derived from reddish sandstone and shale.

In a representative profile in a cultivated field, the surface layer is dark reddish brown channery loam about 5 inches thick. The subsoil is reddish brown, friable channery loam and very channery loam 13 inches thick. The substratum is dark reddish brown very channery loam 8 inches thick. Sandstone bedrock is at a depth of about 26 inches.

The available water capacity is moderate to low, and permeability is moderate. The depth to bedrock, slope, coarse fragments, and stoniness are the main limitations to use.

Representative profile of Oquaga channery loam, 20 to 30 percent slopes, in a pine plantation 2 miles south of Mainesburg in Sullivan Township (Sample number BK–19706 and BK–19707 in test data table) :

Ap—0 to 5 inches; dark reddish brown (5YR 3/3) channery loam; weak fine granular structure; friable, slightly sticky and slightly plastic; many roots; 30 percent coarse fragments; medium acid; clear smooth boundary.

B21—5 to 10 inches; reddish brown (2.5YR 4/4) channery loam; weak fine subangular blocky structure; friable, nonsticky and slightly plastic; common roots; 35 percent coarse fragments; few thin clay films in pores; strongly acid; clear wavy boundary.

B22—10 to 18 inches; reddish brown (2.5YR 4/4) very channery loam; weak fine subangular blocky structure; friable, slightly sticky and nonplastic; few roots; 55 percent coarse fragments; few thin clay films in pores; strongly acid; clear irregular boundary.

C—18 to 26 inches; dark reddish brown (2.5YR 3/4) very channery loam and patches and pockets of pinkish gray (5YR 6/2) and dark reddish gray (5YR 4/2) weathered stones; massive; friable, slightly sticky and slightly plastic; few roots; 65 percent coarse fragments; strongly acid; clear wavy boundary.

R—26 inches; sandstone bedrock.

The solum is 16 to 30 inches thick. Depth to bedrock ranges from 20 to 40 inches. The content of coarse fragments of flat angular sandstone, siltstone, and shale ranges from 15 to 35 percent in the A horizon, from 25 to 60 percent in the B horizon, and as high as 80 percent in the C horizon. The Ap horizon ranges from dark brown (7.5YR 3/2) to dark reddish brown (2.5YR 3/4). The B horizon ranges from strong brown (7.5YR 5/6) to reddish brown (2.5YR 4/4). It is channery silt loam to very channery loam. The profile is medium acid to strongly acid throughout.

Oquaga soils are near Lackawanna, Wellsboro, Morris, and Norwich soils. Oquaga soils are not so deep as those soils.

OgB—Oquaga channery loam, 3 to 12 percent slopes. This soil is gently sloping and is on side slopes and ridgetops. Areas are oblong and elongated and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the subsoil is thicker and the depth to bedrock is slightly greater.

Included with this soil in mapping were some small areas of nearly level Oquaga soils and very stony soils. Also included were some areas of Rock outcrop and Arnot soils.

Most areas of this soil have been cleared and are used for crops. The soil is suited to most of the cultivated crops, grasses, and legumes commonly grown in the county. Droughtiness is the main limitation to use for crops, and erosion control is needed in cultivated areas. The depth to bedrock, coarse fragments, and slope are other limitations to most uses. Capability unit IIe–2.

OgC—Oquaga channery loam, 12 to 20 percent slopes. This soil is sloping and is mainly on side slopes and narrow ridgetops. Areas are irregular in shape and 3 to 75 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the subsoil is slightly thicker and the depth to bedrock is slightly greater.

Included with this soil in mapping were some small areas of gently sloping and moderately steep Oquaga soils and of very stony soils. Also included were some areas of Rock outcrop and Arnot soils.

Most areas of this soil have been cleared and are used for crops or pasture. The soil is suited to most of the cultivated crops, grasses, and legumes commonly grown in the county. Droughtiness is the main limitation to use for crops, and erosion control is needed in cultivated areas. The depth to bedrock, coarse fragments, and slope are other limitations to most uses. Capability unit IIIe–3.

OgD—Oquaga channery loam, 20 to 30 percent slopes. This soil is moderately steep and is mainly on hillsides. Areas are irregular in shape and 3 to 50 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were some small areas of steep Oquaga soils and of very stony soils. Also included were some areas of Rock outcrop and Arnot soils.

Most areas of this soil are used for crops and pasture, or they are idle. The soil is suited to limited cultivation, to pasture, or to hay. If it is cultivated, erosion control is needed. The depth to bedrock, coarse fragments, and slope are limitations to most uses. Capability unit IVe–3.

OsB—Oquaga very stony loam, 3 to 12 percent slopes. This soil is gently sloping and is on ridgetops, benches, and side slopes. Areas are irregular in shape and 4 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of

the series, but the subsoil is thicker, the depth to bedrock is slightly greater, and the surface layer is thin and is not plowed. About 5 to 15 percent of the surface is covered by stones.

Included with this soil in mapping were some small areas of very stony Lordstown, Lackawanna, and Bath soils. Also included were a few areas of Arnot soils and small areas of Rock outcrop.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated, but it can be used for pasture. The depth to bedrock and stoniness are limitations to most uses. Capability unit VIs–1.

OsD—Oquaga very stony loam, 12 to 30 percent slopes. This soil is sloping and moderately steep and is mainly on the sides of ridges and hills. Areas are irregular in shape and 4 to 150 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thin and is not plowed. About 5 to 25 percent of the surface is covered by stones and boulders.

Included with this soil in mapping were some small areas of nearly level, gently sloping, and steep Oquaga soils. Also included were a few areas of Lordstown, Lackawanna, Bath, and Arnot soils and small areas of Rock outcrop.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated, but it is suited to permanent pasture. The depth to bedrock, slope, and stoniness are the main limitations to use. Capability unit VIs–1.

OTF—Oquaga and Lordstown soils, very steep. These soils are steep and very steep and are on hillsides and ridges and on side slopes adjacent to streams. The slope is 30 to 70 percent. Areas are irregular in shape and 6 to 500 acres or more in size. They are mostly very stony or extremely stony, but some are channery silt loam or flaggy loam. Areas of this mapping unit may consist of both Oquaga and Lordstown soils or entirely Oquaga soils or Lordstown soils. Although it is more variable than most mapping units in the county in composition, the total acreage averages about 55 percent Oquaga soils and 25 percent Lordstown soils. The profiles of these soils are similar to those described as representative of the Oquaga and Lordstown series, but the Oquaga soil has a thin unplowed surface layer.

Included with these soils in mapping were some similar and moderately permeable soils in which bedrock is at a depth of more than 40 inches. These soils are commonly at the base of slopes where soil material has accumulated. Also included were some areas of Lackawanna, Arnot, and Bath soils and Rock outcrop.

Most areas of these soils are used for woodland. The soils are not suited to cultivation or to pasture. The slope, depth to bedrock, and stoniness are limitations to most uses. Capability unit VIIs–3.

OVF—Oquaga-Rock outcrop complex, very steep. This mapping unit is steep and very steep and is on valley walls adjacent to streams, mainly along Pine Creek and its tributaries. Slopes are 30 to 100 percent or more. Areas are irregular in shape and generally 100 acres or more in size. The unit is more variable in composition than most mapping units in the county, but it is about 60 percent Oquaga soils and 20 percent Rock outcrop. Most areas are very stony or extremely stony, and the surface layer ranges from channery loam to flaggy silt loam. The profile of the Oquaga soil is similar to the one described as representative of the series, but the surface layer is not plowed.

Included with this unit in mapping were some areas of deep Lackawanna, Wellsboro, and Morris soils on lower slopes and areas of shallow Arnot soils.

This mapping unit is wooded. It is too stony and steep to be cultivated, and it is best suited to woodland or wildlife habitat. The slope, stoniness, depth to bedrock, and rock outcrop are limitations to most uses. Capability unit VIIs–3.

Orrville Series

The Orrville series consists of deep, somewhat poorly drained soils on flood plains. These soils are nearly level and are along streams in the county. They formed in alluvial material that washed from glacial till on the uplands.

In a representative profile the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark brown, friable silt loam 4 inches thick. The subsoil, which extends to a depth of 48 inches, is grayish brown and dark yellowish brown, firm silt loam that has light brownish gray, strong brown, and gray mottles. The substratum is brown silty clay loam to a depth of 66 inches.

The available water capacity is high, and permeability is moderate. A seasonal high water table rises to within 6 to 18 inches of the surface during wet periods. The seasonal high water table and flooding hazard are the main limitations to use.

Representative profile of Orrville silt loam, in a cultivated field south of Middlebury Center and west of Route 287 in Middleburg Township (Sample numbers BK–36387 and BK–36388 in test data table) :

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate coarse granular structure; very friable, slightly sticky and slightly plastic; many roots; slightly acid; abrupt wavy boundary.

A3—8 to 12 inches; dark brown (10YR 4/3) silt loam; few fine faint gray (10YR 5/1) mottles; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; common roots; slightly acid; abrupt wavy boundary.

B21g—12 to 22 inches; grayish brown (10YR 5/2 silt loam; common medium distinct light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm, slightly sticky and slightly plastic; few roots; strongly acid; gradual wavy boundary.

B22g—22 to 38 inches; grayish brown (10YR 5/2) silt loam; many medium distinct gray (N 5/0) and strong brown (7.5YR 5/6) mottles; moderate coarse subangular blocky structure; firm, slightly sticky and slightly plastic; strongly acid; abrupt wavy boundary.

B23—38 to 48 inches; dark yellowish brown

(10YR 4/4) silt loam; many medium prominent gray (10YR 6/1) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm, slightly sticky and slightly plastic; medium acid; gradual wavy boundary.

C—48 to 66 inches; brown (7.5YR 5/4) silty clay loam; many medium distinct gray (N 5/0) and strong brown (7.5YR 5/6) mottles; massive; slightly sticky and slightly plastic; slightly acid.

The solum is 40 to 60 inches thick. The content of coarse fragments is as high as 15 percent in the solum. The A horizon is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2). The B horizon ranges from grayish brown (10YR 5/2) to dark brown (7.5YR 4/4) silt loam to loam or silty clay loam.

Orrville soils are near the well drained Pope soils, the moderately well drained Philo soils, and the very poorly drained Wayland soils.

Ow—Orrville silt loam. This soil is nearly level and is on flood plains. The slope is 0 to 3 percent. Areas are irregular in shape and 3 to 75 acres or more in size.

Included in mapping were some small areas of Pope, Wayland, and Philo soils and some areas of soils that are similar to Orville silt loam but have a reddish subsoil.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is suited to water-tolerant crops and grasses. Artificial drainage increases its suitability for crops. Alfalfa and winter grain are subject to frost-heave damage. The seasonal high water table and flooding hazard are limitations to most uses. Capability unit IIIw–2.

Philo Series

The Philo series consists of deep, moderately well drained soils on flood plains. These soils are nearly level and are along all the streams of Tioga County. They formed in alluvial material that washed from glacial till on the uplands.

In a representative profile in a cultivated field, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is very dark grayish brown, friable silt loam 6 inches thick. The subsoil is dark brown and brown, friable and firm silt loam 15 inches thick. In the lower 10 inches the subsoil has light brownish gray and gray mottles. The substratum is gray silt loam to a depth of 60 inches.

The available water capacity is high, and permeability is moderate. A seasonal high water table rises to within 18 to 36 inches of the surface during wet periods. The seasonal high water table and flooding hazard are the main limitations to use.

Representative profile of Philo silt loam, in a cultivated field 0.6 mile northeast of Tioga in Tioga Township:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam; moderate fine and medium granular structure; very friable; many roots; medium acid; gradual wavy boundary.

A3—9 to 15 inches; very dark grayish brown (10YR 3/2) silt loam; moderate thick platy structure; friable; many roots; medium acid; abrupt wavy boundary.

B21—15 to 20 inches; dark brown (10YR 4/3) silt loam; weak medium and coarse subangular blocky structure; friable, slightly sticky and slightly plastic; few roots; strongly acid; gradual wavy boundary.

B22—20 to 30 inches; brown (10YR 5/3) silt loam; common fine faint light brownish gray (10YR 6/2) and gray (10YR 5/1) mottles; weak fine and medium subangular blocky structure; firm, slightly sticky and slightly plastic; few roots; thin patchy clay films; strongly acid; gradual wavy boundary.

Cg—30 to 66 inches; gray (10YR 5/1) silt loam; many medium distinct yellowish red (5YR 5/6) mottles; massive; firm, slightly sticky and slightly plastic; strongly acid.

The solum is 20 to 40 inches thick. In places, stratified sand and gravel are below a depth of 40 inches. The A horizon ranges from very dark grayish brown (10YR 3/2) to yellowish brown (10YR 5/6). The content of coarse fragments in the A horizon and B horizon ranges from 0 to 20 percent. The B horizon and C horizon are mainly silt loam, but are loam and sandy loam in places. The C horizon ranges from light yellowish brown (10YR 6/4) to dark gray (N 4/0). The profile is very strongly acid to medium acid throughout.

Philo soils are near Pope, Orrville, and Wayland soils. Philo soils are better drained than Orrville and Wayland soils and are wetter than Pope soils.

Ph—Philo silt loam. This soil is nearly level and is on flood plains. The slope is 0 to 3 percent. Areas are irregular in shape and range from 3 to 75 acres or more in size.

Included in mapping were some small areas of Pope and Orrville soils.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is suited to water-tolerant crops and to grasses. Artificial drainage increases its suitability for crops. A seasonal high water table and flooding hazard are limitations for most uses. Capability unit IIw–1.

Pope Series

The Pope series consists of deep, well drained soils on flood plains. These soils are nearly level and are along streams in the county. They formed in alluvial material that washed from glacial till on the uplands.

In a representative profile the surface layer is dark brown fine sandy loam about 7 inches thick. The subsoil is dark brown friable loam 39 inches thick. The substratum is dark yellowish brown sandy loam to a depth of 66 inches.

The available water capacity is high, and permeability is moderate. The flooding hazard is the main limitation to use.

Representative profile of Pope fine sandy loam, in an area of Pope soils, in a cultivated field 2 miles north

of Tioga along the west bank of the Tioga River in Tioga Township:

Ap—0 to 7 inches; dark brown (10YR 3/3) fine sandy loam; weak fine granular structure; very friable, nonsticky and nonplastic; many roots; medium acid; abrupt smooth boundary.

B21—7 to 30 inches; dark brown (10YR 4/3) loam; weak medium and coarse subangular blocky structure; friable, slightly sticky and nonplastic; common roots; medium acid; gradual wavy boundary.

B22—30 to 46 inches; dark brown (7.5YR 4/4) loam; weak medium and coarse subangular blocky structure; friable, slightly sticky and nonplastic; common roots; strongly acid; gradual wavy boundary.

C—46 to 66 inches; dark yellowish brown (10YR 4/4) sandy loam; massive; very friable, nonsticky and nonplastic; strongly acid.

The solum is 30 to 50 inches thick. The Ap horizon ranges from silt loam to sandy loam and from medium acid to strongly acid. The content of coarse fragments is 0 to 20 percent in the A horizon and B horizon and is as high as 30 percent in the C horizon. The B horizon and C horizon range from brown (10YR 4/3) to reddish yellow (7.5YR 6/6).

Pope soils are near the moderately well drained Philo soils, the somewhat poorly drained Orrville soils, and the very poorly drained Wayland soils.

Po—Pope soils. These soils are nearly level and are on flood plains. Slope is 0 to 3 percent. Areas are oblong and irregular in shape and 3 to 150 acres or more in size. One of these soils has the profile described as representative of the series. The other soils are similar, but their surface layer is silt loam or sandy loam.

Most areas of these soils have been cleared and are used for crops. These soils are suited to all cultivated crops, grasses, and legumes commonly grown in the county. The flooding hazard is the main limitation to use, and crops are damaged by flooding at times. Capability unit IIw-1.

Pp—Pope fine sandy loam, high bottom. This soil is nearly level and is on high bottoms or low stream terraces on flood plains. It is above the level of all but the highest floodwaters. The slope is 0 to 3 percent. Areas are oblong and irregular in shape and 3 to 75 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the subsoil contains more clay.

Included in mapping were a few small areas of Philo soils.

This soil has been cleared and is used for crops. It is suited to all cultivated crops, grasses, and legumes commonly grown in the county. Flood damage to crops is rare, but the flooding hazard is a limitation to some uses. Capability unit I-1.

Rexford Series

The Rexford series consists of deep, somewhat poorly drained to poorly drained soils on glacial outwash terraces. These soils are nearly level to gently sloping and are along the fringes of the larger streams in the county. They formed in water-sorted material derived mostly from sandstone and shale.

In a representative profile in a cultivated field, the surface layer is dark grayish brown silt loam about 8 inches thick. The upper 9 inches of the subsoil is yellowish brown and grayish brown, friable and firm loam that has grayish brown and yellowish brown mottles. The lower 21 inches is brown and dark brown, very firm and brittle gravelly loam that has gray, strong brown, and light gray mottles. The upper part of the substratum is brown gravelly sandy loam about 6 inches thick; the lower part is stratified sand and gravel to a depth of 60 inches.

The available water capacity is moderate, and permeability is slow. A high water table rises to within 6 to 18 inches of the surface during wet periods. The slow permeability and high water table are the main limitations to use.

Representative profile of Rexford silt loam, 0 to 3 percent slopes, in a cultivated field 3.5 miles south of Mansfield and 0.4 mile east of intersection of Pennsylvania Highway 660 and U.S. Highway in Covington Township:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; very friable, slightly sticky and slightly plastic; many roots; 10 percent gravel; slightly acid; abrupt wavy boundary.

B21—8 to 12 inches; yellowish brown (10YR 5/4) loam; common fine faint grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; friable, slightly sticky and slightly plastic; many roots; 10 percent gravel; medium acid; clear wavy boundary.

B22—12 to 17 inches; grayish brown (10YR 5/2) loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; firm, slightly sticky and slightly plastic; common roots; 10 percent gravel; medium acid; gradual wavy boundary.

IIBx1—17 to 30 inches; brown (7.5YR 5/4) gravelly loam; many fine distinct gray (10YR 6/1) and strong brown (7.5YR 5/6) mottles; moderate very coarse prismatic structure parting to moderate medium and thick platy; very firm and brittle, slightly sticky and slightly plastic; few thin clay films; 25 percent gravel; strongly acid; gradual wavy boundary.

IIBx2—30 to 38 inches; dark brown (7.5YR 4/4) gravelly loam; many coarse prominent light gray (10YR 7/2) and strong brown (7.5YR 5/8) mottles; moderate very coarse prismatic structure parting to moderate thick platy and weak fine subangular blocky; very firm and brittle, slightly sticky and slightly plastic; thin patchy clay films in pores; 15 percent gravel; strongly acid; abrupt wavy boundary.

IIIC—38 to 44 inches; brown (10YR 5/3) gravelly sandy loam; massive; firm, nonsticky and nonplastic; 35 percent gravel; strongly acid; abrupt wavy boundary.

IVC—44 to 60 inches; olive brown (2.5Y 4/4) stratified sand and gravel; strongly acid.

The solum is 24 to 40 inches thick. Stratified sand and gravel are at a depth of 35 to 55 inches. Depth to the fragipan ranges from 15 to 24 inches. Reaction is very strongly acid to medium acid in the A horizon and B2 horizon and strongly acid to slightly acid in the Bx horizon and C horizon. The Ap horizon is dark gray (10YR 4/1) or dark grayish brown (10YR 4/2). The B2 horizon ranges from light yellowish brown (2.5Y 6/4) to brown (7.5YR 5/2). The Bx horizon ranges from dark yellowish brown (10YR 5/4) to reddish brown (5YR 4/4) and has low- and high-chroma mottles. The IIIC horizon is similar in color to the Bx horizon.

Rexford soils are near Wyoming, Chenango, and Braceville soils. Rexford soils are wetter than those soils.

RxA—Rexford silt loam, 0 to 3 percent slopes. This soil is nearly level and is in slightly concave positions on stream terraces. Areas are irregular in shape and 3 to 50 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were some small areas of Rexford soils that have a gravelly loam surface layer and a few small areas of similar soils that are very poorly drained.

Most areas of this soil have been cleared and are used for crops. The soil is suited to crops, grasses, and legumes that are tolerant of some wetness. Artificial drainage increases its suitability for crops. Alfalfa and winter grain are subject to frost-heave damage. A high water table and slow permeability are limitations to most uses. Capability unit IIIw–3.

RxB—Rexford silt loam, 3 to 10 percent slopes. This soil is gently sloping and is in slightly concave areas on stream terraces. Areas are irregular and elongated in shape and 3 to 40 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the upper part of the subsoil has fewer mottles.

Included in mapping were some small areas of Braceville soils and some areas of Rexford soils that have a gravelly loam surface layer.

Most areas of this soil have been cleared and are used for crops. The soil is suited to crops, grasses, and legumes that are tolerant of some wetness. Artificial drainage increases its suitability for crops. Alfalfa and winter grain are subject to frost-heave damage. A high water table, slow permeability, and slope are limitations to most uses. Capability unit IIIw–3.

Stony Land, Wet

Sw—Stony land, wet. This is a nearly level miscellaneous area in depressions and on mountaintops. The slope is 0 to 3 percent; 50 to 90 percent of the surface is covered by stones. A high water table is at or near the surface during much of the year.

Included in mapping were some small areas of very poorly drained soils and a few areas where stones cover less than 50 percent of the surface.

Vegetation consists of moisture-tolerant grasses and shrubs. This mapping unit is best suited to wildlife habitat. The high water table and stoniness are limitations to most uses. Capability unit VIIIs–1.

Volusia Series

The Volusia series consists of deep, somewhat poorly drained soils on the uplands. These soils are nearly level to steep and are on convex hillsides and mountaintops. They formed in glacial till derived from gray and brown sandstone, siltstone, and shale.

In a representative profile in woodland, 2 inches of organic material overlies a surface layer of light brownish gray and dark brown channery silt loam about 4 inches thick. The upper 12 inches of the subsoil is brown and light brownish gray, friable channery silt loam and channery loam that has light brownish gray, yellowish brown, and strong brown mottles. Below that is 40 inches of dark grayish brown, very firm and brittle channery loam that has gray, strong brown, light brownish gray, olive brown, and yellowish brown mottles.

The available water capacity is moderate, and permeability is very slow. A seasonal high water table rises to within 6 to 18 inches of the surface during wet periods. The very slow permeability, seasonal high water table, slope, and stoniness are the main limitations to use.

Representative profile of Volusia channery silt loam, 8 to 15 percent slopes, in a woodlot 1.25 miles east of Morris Run in Ward Township:

O2—2 inches to 0; very dark gray (10YR 3/1) partly decomposed organic matter.

A2—0 to 1 inch; light brownish gray (10YR 6/2) channery silt loam; weak fine granular structure; very friable, slightly sticky and nonplastic; many roots; 15 percent coarse fragments; very strongly acid; abrupt wavy boundary.

A3—1 inch to 4 inches; dark brown (10YR 4/3) channery silt loam; weak fine granular structure; friable, slightly sticky and slightly plastic; many roots; 15 percent coarse fragments; very strongly acid; gradual wavy boundary.

B21—4 to 8 inches; brown (10YR 5/3) channery silt loam; common fine faint light brownish gray (10YR 6/2) mottles; moderate fine and medium subangular blocky structure; friable, slightly sticky and nonplastic; few roots; 15 percent coarse fragments; very strongly acid; gradual wavy boundary.

B22g—8 to 16 inches; light brownish gray (10YR 6/2) channery loam; many medium distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; few roots; 20 percent coarse fragments; very strongly acid; gradual wavy boundary.

Bx1g—16 to 38 inches; dark grayish brown (10YR 4/2) channery loam; many medium distinct gray (10YR 6/1) and strong brown (7.5YR 5/6) mottles; weak very coarse prismatic structure parting to strong thick platy; very firm and brittle, slightly sticky and nonplastic; thin patchy clay films; 35 percent coarse fragments; very strongly acid; gradual wavy boundary.

Bx2g—38 to 56 inches; dark grayish brown (2.5Y 4/2) channery loam; many medium distinct light brownish gray (2.5Y 6/2), olive brown (2.5Y 4/4), and yellowish brown (10YR 5/6) mottles; weak very coarse prismatic structure parting to strong coarse subangular blocky; very firm and brittle, slightly sticky and nonplastic; thin patchy clay films; 35 percent coarse fragments; strongly acid.

The solum is 40 to 60 inches thick. Depth to bedrock ranges from 40 inches to many feet. Depth to the fragipan is 12 to 20 inches. The content of coarse fragments ranges from 10 to 20 percent in the A horizon and B horizon. It is 15 to 60 percent in the Bx horizon and C horizon. The A horizon and B2 horizon are very strongly to strongly acid, and the Bx2 horizon ranges from strongly acid to slightly acid. The Ap horizon, where present ranges from very dark grayish brown (2.5Y 3/2) to brown (10YR 5/3). The B2 horizon ranges from light brownish gray (10YR 6/2) to brown (10YR 5/3) and has few to many mottles. The Bx horizon ranges from olive brown (5Y 4/4) to dark grayish brown (10YR 4/2) and has few to many mottles. These horizons range from silt loam to loam or silty clay loam.

Volusia soils are near the well drained Bath and Lordstown soils, the moderately well drained Mardin soils, and the poorly drained Chippewa soils. Volusia soils are better drained than Chippewa soils, and they are wetter than Bath, Lordstown, and Mardin soils.

VoA—Volusia channery silt loam, 0 to 3 percent slopes. This soil is nearly level and is on hilltops and mountaintops. Areas are irregular in shape and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is plowed or disturbed and the fragipan is closer to the surface.

Included with this soil in mapping were some small areas of Chippewa soils and some areas of gently sloping Volusia soils. Also included were some areas of soils that are similar to this Volusia soil but that are neutral in reaction below a depth of 40 inches and areas where bedrock is at a depth of less than 40 inches.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is suited to water-tolerant crops and grasses. Artificial drainage increases its suitability for crops. Alfalfa and winter grain are subject to frost-heave damage. A seasonal high water table and very slow permeability are limitations to most uses. Capability unit IIIw–3.

VoB—Volusia channery silt loam, 3 to 8 percent slopes. This soil is gently sloping and is on long or slightly concave hillsides and mountaintops. Areas of this soil are irregular in shape and 3 to 150 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is plowed and the fragipan is slightly closer to the surface.

Included with this soil in mapping were some small areas of nearly level and sloping Volusia soils, areas of Chippewa soils, small areas of very stony soils, and areas of soils that are similar to this Volusia soil but that are neutral in reaction below a depth of 40 inches.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is suited to water-tolerant crops and grasses. Artificial drainage increases its suitability for crops. Alfalfa and winter grain are subject to frost-heave damage. A seasonal high water table and very slow permeability are limitations to most uses. Capability unit IIIw–3.

VoC—Volusia channery silt loam, 8 to 15 percent slopes. This soil is sloping and is on long or slightly concave sides of hills and mountains. Areas are irregular in shape and 3 to 200 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were some small areas of gently sloping and moderately steep Volusia soils, a few small areas of stony soils, small areas of Mardin soils, and some areas of soils that are similar to this Volusia soil but that are neutral in reaction below a depth of 40 inches.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is suited to water-tolerant crops and grasses. If it is cultivated, erosion control is needed. Alfalfa and winter grain are subject to frost-heave damage. A seasonal high water table, very slow permeability, and slope are limitations to most uses. Capability unit IIIe–4.

VoD—Volusia channery silt loam, 15 to 25 percent slopes. This soil is moderately steep and is mainly on side slopes and ridges. Areas are oblong and irregular in shape and 3 to 150 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but in most places the surface layer is plowed.

Included in mapping were some areas of sloping and steep Volusia soils and small areas of Mardin and Lordstown soils.

Most areas of this soil have been cleared and are used for crops and pasture, or they are idle. The soil is suited to limited cultivation, to hay, or to pasture. A seasonal high water table, very slow permeability, and slope are limitations to most uses. Capability unit IVe–4.

VoD3—Volusia channery silt loam, 15 to 25 percent slopes, eroded. This soil is moderately steep and is mainly on side slopes and ridges. Areas are oblong and irregular in shape and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is plowed. Nearly all of the original surface layer has been lost to erosion, and in some places the fragipan is immediately below the surface.

Included in mapping were small areas of sloping and steep Volusia soils and some areas of Mardin and Lordstown soils.

Most areas of this soil have been cleared and are used for pasture or they are idle. Because of past ero-

sion and slope, the soil is best suited to pasture, trees, or wildlife habitat. A seasonal high water table, very slow permeability, and slope are limitations to most uses. Capability unit VIe–1.

VoE3—Volusia channery silt loam, 25 to 35 percent slopes, eroded. This soil is steep and is on side slopes and ridges. Areas are oblong and irregular in shape and 3 to 40 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is disturbed. Nearly all of the original surface layer has been lost through erosion, and in many places the fragipan is immediately below the surface.

Included in mapping were a few areas of Mardin soils and moderately steep and very steep Volusia soils.

This soil has been cleared, but most of it has reverted to brush and trees. It is too steep and eroded to be used for pasture, and it is best suited to trees or wildlife habitat. A seasonal high water table, very slow permeability, and slope are limitations to most uses. Capability unit VIIe–2.

VsB—Volusia very stony silt loam, 0 to 8 percent slopes. This is a nearly level and gently sloping soil on mountaintops, ridges, and side slopes. Areas are irregular in shape and 3 to 150 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thicker, and the fragipan is closer to the surface. About 5 to 15 percent of the surface is covered by stone or boulders.

Included in mapping were some small areas of very stony Chippewa and Mardin soils.

Most areas of this soil are used for woodland. The soil is too stony to be used for cultivated crops or pasture, and it is best suited to trees and wildlife habitat. The seasonal high water table, very slow permeability, and stoniness are limitations to most uses. Capability unit VIIs-1.

VsD—Volusia very stony silt loam, 8 to 25 percent slopes. This is a sloping and moderately steep soil mainly on hillsides and mountainsides. Areas are irregular in shape and 3 to 50 acres or more in size. About 5 to 20 percent of the surface is covered by stones or boulders.

Included with this soil in mapping were some small areas of very stony Mardin soils and Volusia soils that have more than 20 percent stone cover.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated or used for pasture, and it is best suited to trees or wildlife habitat. A seasonal high water table, very slow permeability, slope, and stoniness are limitations to most uses. Capability unit VIIs-1.

VtB—Volusia extremely stony silt loam, 0 to 8 percent slopes. This soil is nearly level and gently sloping and is at the base of slopes, along drainageways, and at the head of streams. Areas are irregular in shape and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thicker. About 15 to 40 percent of the surface is covered by stones and boulders.

Included in mapping were some small areas of very stony Volusia, Mardin, and Chippewa soils.

This soil is used for woodland. It is too stony to be cultivated, and it is best suited to trees or wildlife habitat. A seasonal high water table, very slow permeability, and stoniness are limitations to most uses. Capability unit VIIs-1.

VvB—Volusia channery silt loam, silty substratum, 3 to 8 percent slopes. This soil is gently sloping and is on lower slopes of valleys in the northern half of the county. Areas are irregular in shape and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the substratum between depths of 40 and about 72 inches is alternate layers of lacustrine silt and clay.

Included with this soil in mapping were a few small areas of sloping Volusia soils and a few areas of Morris and Wyoming soils. Almost all of these soils are underlain by lacustrine silt and clay.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is suited to water-tolerant crops and grasses. Artificial drainage increases its suitability for crops. Alfalfa and winter grain are subject to frost-heave damage. A seasonal high water table and very slow permeability are limitations to most uses. Because the soil is also unstable, areas should be carefully investigated before being disturbed. Capability unit IIIw–3.

VvC—Volusia channery silt loam, silty substratum, 8 to 15 percent slopes. This soil is sloping and is on lower slopes of valleys in the northern half of the county. Areas are irregular in shape and 3 to 40 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the substratum between depths of 40 and about 72 inches is alternate layers of lacustrine silt and clay.

Included with this soil in mapping were a few small areas of gently sloping and moderately steep Volusia soils. Also included were small areas of eroded soils and some areas of Morris and Wyoming soils. Almost all of these included soils are underlain by lacustrine silt and clay.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is suited to water-tolerant crops and grasses. Alfalfa and winter grain are subject to frost-heave damage. If the soil is cultivated, erosion control is needed. A seasonal high water table and very slow permeability are limitations to most uses. Because the soil is also unstable (fig. 9), areas should be carefully investigated before being disturbed. Capability unit IIIe–4.

VvD3—Volusia channery silt loam, silty substratum, 15 to 25 percent slopes, eroded. This soil is moderately steep and is on the uplands along streams in the northern half of the county. Areas are long and irregular in shape and 3 to 40 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the substratum between depths of 40 and about 72 inches is alternate layers of lacustrine silt and clay.

Included in mapping were small areas of steep soils, some areas of Wellsboro and Mardin soils, and some areas of soils that contain lacustrine silt and clay in the subsoil.

This soil is too steep and unstable to be cultivated. It is best suited to pasture or trees. A seasonal high water table, and slope are limitations to most uses.

Figure 9.—**Soil movement on cut slopes of a Volusia soil, silty substratum. These soils need careful investigation before they are disturbed.**

Because the soil is unstable, areas should be carefully investigated before being disturbed. Capability unit VIe-1.

Wayland Series

The Wayland series consists of deep, very poorly drained soils on flood plains. These are nearly level or slightly depressional soils along the streams in the county. They formed in alluvial material that washed from glacial till on the uplands.

In a representative profile the surface layer is very dark gray silty clay loam about 9 inches thick. The subsoil is dark gray and gray, firm silty clay loam that has strong brown and yellowish red mottles. It is 21 inches thick. The substratum is gray silty clay loam to a depth of 64 inches.

The available water capacity is high, and permeability is slow. The water table is at the surface during most of the year.

Representative profile of Wayland silty clay loam near a drainage ditch west of Heise Run along Route 6:

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam; moderate fine and medium granular structure; friable, sticky and plastic; many roots; medium acid; clear wavy boundary.

B21g—9 to 20 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct strong brown (7.5YR 5/6) and yellowish red (5YR 4/8) mottles; weak coarse prismatic structure parting to weak coarse angular blocky; firm, sticky and plastic; common roots; medium acid; gradual wavy boundary.

B22g—20 to 30 inches; gray (10YR 5/1) silty clay loam; common fine distinct yellowish red (5YR 4/8) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm, sticky and plastic; few roots; slightly acid; gradual wavy boundary.

Cg—30 to 64 inches; gray (5Y 5/1) silty clay loam; few fine distinct yellowish red (5YR 4/6) mottles; massive; firm, very sticky and plastic; slightly acid.

The solum is 25 to 30 inches thick. Depth to sand and gravel is more than 40 inches, but thin sandy lenses are at a depth of less than 40 inches in places. The A horizon ranges from black (N 2/0) to very dark grayish brown (10YR 3/2). The Bg horizon ranges from gray (N 5/0) in the upper part to pinkish gray (7.5YR 6/2) in the lower part. The B21g horizon is strongly acid to medium acid.

Wayland soils are near the well drained Pope soils, the moderately well drained Philo soils, and the somewhat poorly drained Orrville soils.

Wa—Wayland silty clay loam. This soil is nearly level and is on flood plains. The slope is 0 to 3 percent. Areas are irregular in shape and 3 to 50 acres or more in size.

Included in mapping were some small areas of Orrville and Carlisle soils.

About half the acreage of this soil is in woodland, and the cleared part is used for hay or pasture. If adequately drained, the soil is suited to water-tolerant grasses and crops. A high water table and flooding hazard are limitations to most uses. Capability unit IVw-3.

Wellsboro Series

The Wellsboro series consists of deep, moderately well drained soils on the uplands. These soils are nearly level to moderately steep and are on smooth to convex side slopes, benches, and tops of hills and ridges. They formed in glacial till derived from mixed red and brown sandstone, siltstone, and shale.

In a representative profile in a cultivated field, the surface layer is dark brown and reddish brown, channery loam about 9 inches thick. The subsoil extends to a depth of 50 inches. In sequence from the top it is 7 inches of reddish brown, friable channery loam; 4 inches of brown, friable channery fine sandy loam that has light gray and yellowish red mottles; and 30 inches of reddish brown, very firm and brittle gravelly loam that has many pinkish gray and yellowish red mottles. The substratum is reddish brown very gravelly loam to a depth of 60 inches.

The available water capacity is moderate, and permeability is slow. A seasonal high water table rises to within 18 to 36 inches of the surface during wet periods. The slow permeability, seasonal high water table, slope, and stoniness are the main limitations to use.

Representative profile of Wellsboro channery loam, 8 to 15 percent slopes, in a pine plantation 2 miles west of Liberty in Liberty Township (Sample numbers BK-36385 and BK-36386 in test data table):

Ap—0 to 6 inches; dark brown (7.5YR 3/2) channery loam; weak fine granular structure; very friable, nonsticky and slightly plastic; many roots; 20 percent coarse fragments; strongly acid; abrupt wavy boundary.

A2—6 to 9 inches; reddish brown (5YR 4/3) channery loam; weak thin platy structure; friable; many roots; 15 percent coarse fragments; strongly acid; clear wavy boundary.

B2—9 to 16 inches; reddish brown (5YR 4/3) channery loam; weak fine subangular blocky structure; friable, slightly sticky and slightly plastic; common roots; 15 percent coarse fragments; strongly acid; gradual wavy boundary.

A'2—16 to 20 inches; brown (7.5YR 5/4) channery fine sandy loam; few fine distinct light gray (5YR 7/1) and yellowish red (5YR 5/8) mottles; weak fine subangular blocky structure; friable; common roots; 15 percent coarse fragments; strongly acid; abrupt wavy boundary.

B'x1—20 to 30 inches; reddish brown (5YR 5/3) gravelly loam; many medium pinkish gray (5YR 6/2) and yellowish red (5YR 5/8) mottles; pinkish gray (7.5YR 7/2) prism faces that have yellowish red (5YR 5/6) rinds; weak very coarse prismatic structure parting to moderate medium subangular blocky; very firm and brittle, slightly sticky and slightly plastic; few thin clay films; 35 percent coarse fragments; strongly acid; gradual wavy boundary.

B'x2—30 to 50 inches; reddish brown (5YR 5/3) gravelly loam; many coarse distinct pinkish gray (5YR 6/2) and yellowish red (5YR 5/8) mottles; pinkish gray (7.5YR 7/2) prism faces have yellowish red (5YR 5/6) rinds; weak very coarse prismatic structure parting to weak thick platy and weak medium subangular blocky; very firm and brittle, slightly sticky and slightly plastic; few thin clay films and common black coatings on ped faces; 40 percent coarse fragments; strongly acid; gradual wavy boundary.

C—50 to 60 inches; reddish brown (2.5YR 4/4) very gravelly loam; massive; firm; 50 percent coarse fragments; strongly acid.

The solum is 40 to 70 inches thick. Depth to bedrock ranges from 40 inches to many feet. Depth to fragipan is 16 to 26 inches. The content of coarse fragments of angular or rounded sandstone, siltstone, or shale ranges from 10 to 40 percent in individual layers of the A horizon and B2 horizon and from 15 to 50 percent in the Bx horizon and C horizon. The Ap horizon ranges from dark reddish brown (5YR 3/2) to dark brown (10YR 4/3). The B2 horizon ranges from reddish brown (2.5YR 4/4) to strong brown (7.5YR 5/6). The fine earth part ranges from loam to silt loam. The Bx horizon ranges from dusky red (10R 3/2) to reddish brown (5YR 5/4) and has gray (N 5/0) to yellowish red (5YR 5/8) mottles. The fine earth part is loam to silt loam. The Bx horizon and C horizon range from strongly acid to medium acid.

Wellsboro soils are near the moderately deep Oquaga soils and the deep Lackawanna, Morris, and Norwich soils. Wellsboro soils are better drained than Morris and Norwich soils, and they are wetter than Oquaga and Lackawanna soils.

WeA—Wellsboro channery loam, 0 to 3 percent slopes. This soil is nearly level and is on hilltops. Areas are oblong and irregular in shape and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the fragipan is slightly closer to the surface.

Included in mapping were a few small areas of Lackawanna, Morris, and Norwich soils.

Most areas of this soil have been cleared and are used for crops. The soil is suited to most of the cultivated crops, grasses, and legumes commonly grown in the county. Alfalfa and winter grain are subject to frost-heave damage. A seasonal high water table and slow permeability are limitations to many uses. Capability unit IIw-2.

WeB—Wellsboro channery loam, 3 to 8 percent slopes. This soil is gently sloping and is on side slopes and ridgetops. Areas are oblong or irregular in shape

and 4 to 125 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the fragipan is slightly closer to the surface.

Included with this soil in mapping were a few small areas of nearly level and gently sloping Lackawanna and Morris soils. Also included were some small areas of very stony soils.

Most areas of this soil have been cleared and are used for crops. The soil is suited to most of the cultivated crops, grasses, and legumes commonly grown in the county. Alfalfa and winter grain are subject to frost-heave damage. A seasonal high water table and slow permeability are limitations to many uses. Capability unit IIw–2.

WeC—Wellsboro channery loam, 8 to 15 percent slopes. This soil is sloping and is on side slopes and hilltops. Areas are oblong or irregular in shape and 3 to 100 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were a few small areas of Lackawanna soils and some small areas of gently sloping Morris and Wellsboro soils. Also included were some small areas of very stony soils.

Most areas of this soil have been cleared and are used for crops or pasture. The soil is suited to most of the cultivated crops, grasses, and legumes commonly grown in the county. Alfalfa and winter grain are subject to frost-heave damage. If the soil is cultivated, erosion control is needed. A seasonal high water table, slow permeability, and slope are limitations to many uses. Capability unit IIIe–2.

WeD—Wellsboro channery loam, 15 to 25 percent slopes. This soil is moderately steep and is mainly on hillsides. Areas are irregular in shape and 4 to 75 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the fragipan is at a slightly greater depth.

Included in mapping were some small areas of moderately steep and steep Lackawanna and Oquaga soils and some areas of very stony soils.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is suited to hay, to pasture, and to limited cultivation. Erosion control is needed if this soil is cultivated. A seasonal high water table, slow permeability, and slope are limitations to most uses. Capability unit IVe–2.

WsB—Wellsboro very stony loam, 0 to 8 percent slopes. This soil is nearly level and gently sloping and is on ridgetops, benches, and side slopes. Areas are oblong and irregular in shape and 5 to 75 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface is thin and is not plowed. About 3 to 15 percent of the surface is covered by stones.

Included in mapping were some small areas of nearly level and gently sloping Oquaga, Morris, and Lackawanna soils.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated, but it can be used for permanent pasture. It is suited to woodland and wildlife habitat. A seasonal high water table, slow permeability, and stoniness are limitations to most uses. Capability unit VIs–1.

WsD—Wellsboro very stony loam, 8 to 25 percent slopes. This soil is sloping and moderately steep and is mainly on side slopes. Areas are irregular in shape and 5 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thin and is not plowed. About 5 to 15 percent of the surface is covered by stones.

Included in mapping were some small areas of sloping and moderately steep Oquaga, Lackawanna, and Morris soils.

Most areas of this soil are used for woodland. The soil is too stony to be cultivated, but it can be used for permanent pasture. It is suited to woodland and wildlife habitat. A seasonal high water table, slow permeability, slope, and stoniness are limitations to most uses. Capability unit VIs–1.

Wyoming Series

The Wyoming series consists of deep, somewhat excessively drained soils on glacial outwash terraces. These soils are nearly level to very steep and are mainly along the fringes of stream valleys. They formed in water-sorted sand and gravel derived from sandstone, siltstone, and shale.

In a representative profile in an idle field, the surface layer is dark grayish brown gravelly sandy loam about 7 inches thick. The subsoil is dark yellowish brown and brown, very friable very gravelly sandy loam 23 inches thick. The substratum is brown stratified sand, gravel, and cobblestones to a depth of 80 inches.

The available water capacity is low, and permeability is rapid. Droughtiness, coarse fragments, and slope are the main limitations to use.

Representative profile of Wyoming gravelly sandy loam, 20 to 30 percent slopes, in an idle field, 3.1 miles west of Lambs Creek in Richmond Township (Sample numbers BK–34207 and BK–34208 in test data table):

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) gravelly sandy loam; weak fine granular structure; very friable; many roots; 45 percent coarse fragments; strongly acid; clear smooth boundary.

B2—7 to 17 inches; dark yellowish brown (10YR 4/4) very gravelly sandy loam; weak fine subangular blocky structure; very friable; common roots; 60 percent coarse fragments; medium acid; clear wavy boundary.

B3—17 to 30 inches; brown (10YR 5/3) very gravelly sandy loam; weak fine subangular blocky structure; very friable; common roots; 60 percent coarse fragments; medium acid; clear wavy boundary.

IIC—30 to 80 inches; brown (10YR 4/3) stratified sand, gravel, and cobblestones; single grained; loose; medium acid.

The solum is 20 to 35 inches thick. Depth to bedrock is more than 5 feet and generally exceeds 10 feet. The content of coarse fragments of water-rounded gravel ranges from 35 to 50 percent in the A horizon, 35 to 60 percent in the B horizon, and 35 to 75 percent in the C horizon. The Ap horizon ranges from very dark grayish brown (10YR 3/2) to reddish brown (5YR 5/4). The B horizon ranges from dark brown (10YR

4/3) to reddish brown (2.5YR 5/4). The fine earth part ranges from loam to sandy loam. The profile is strongly acid to medium acid throughout.

Wyoming soils are near Chenango, Braceville, and Rexford soils on terraces and near Pope and Philo soils on flood plains. Wyoming soils contain more sand and gravel than any of those soils, and they are better drained than Braceville, Rexford, and Philo soils.

WyC—Wyoming gravelly sandy loam, 12 to 20 percent slopes. This soil is sloping and is on outwash terraces in stream valleys of the county. Areas are elongated in shape and 2 to 40 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the depth to stratified sand, gravel, and cobblestones is slightly greater.

Included in mapping were some areas of gently sloping and moderately steep Wyoming soils, of Chenango soils, and of soils that do not contain gravel in the upper 20 inches of the profile.

Most areas of this soil have been cleared and are used for crops and pasture. The soil is droughty, but it is suited to most of the cultivated crops commonly grown in the county. The coarse fragments and slope are limitations to most uses. Ground water contamination is possible if the soil is used for sewage effluent disposal. Capability unit IVs–1.

WyD—Wyoming gravelly sandy loam, 20 to 30 percent slopes. This soil is moderately steep and is in convex areas on outwash terraces in stream valleys of the county. Areas are long and narrow in shape and 3 to 35 acres or more in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were some areas of sloping Wyoming soils and a few small areas of Chenango soils.

Most areas of this soil are used for crops and pasture, or they are idle. The soil is suited to limited cultivation, to hay, and to pasture. If it is cultivated, erosion control is needed. The coarse fragments and slope are limitations to most uses. Ground water contamination is possible if the soil is used for sewage effluent disposal. Capability unit IVe–1.

WyF—Wyoming gravelly sandy loam, 30 to 50 percent slopes. This soil is steep and very steep and is in convex areas on outwash terraces in stream valleys of the county. Areas of this soil are long and narrow in shape and 4 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thinner, and stratified sand, gravel, and cobblestones are closer to the surface.

Included in mapping were a few small areas of Chenango soils and a few areas of soils that formed in mixed glacial till and glacial outwash.

Most areas of this soil are used for woodland, and most previously cleared areas have been planted to trees. The soil is too steep and droughty to be cultivated or to be used for pasture. The slope, droughtiness, and coarse fragments are limitations to most uses. Capability unit VIIe–1.

Wz—Wyoming gravelly loam, flooded. This soil is nearly level and is on flood plains of small streams. It is subject to flooding from stream overflow. Areas of this soil are long and narrow in shape and 3 to 75 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the solum is thinner.

Included in mapping were some areas of Alluvial land.

Most areas of this soil are used for hay and pasture, but some are used for crops. The soil is droughty, but it is suited to most grasses and crops commonly grown in the area, to pasture, and to wildlife habitat. The droughtiness and flooding hazard are limitations to most uses. Capability unit IVw–1.

Use and Management of the Soils

This section deals with the soils of Tioga County in relation to crops and pasture, woodland, wildlife, land use planning, recreation development, and engineering.

The soils of Tioga County are used mainly for field crops, hay, pasture, and forest products. A few areas of soils are used as sites for schools, homes, and factories. In addition, some of the soils are used for wildlife food and cover, and some are used as sites for recreational facilities.

Crops and Pasture [2]

In the following pages, the capability classification used by the Soil Conservation Service is explained; the capability units in which soils are grouped according to their suitability for crops are described; and estimated yields are given for specified crops under two levels of management.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, and for engineering.

In the capability system, all kinds of soils are grouped at three levels: the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

[2] ROBERT L. BOND, state resource conservationist, Soil Conservation Service, helped prepare this section.

Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. (None in Tioga County.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–1 or VIIs–1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability unit

Certain practices are basic to good soil management. Among these are the selection of a suitable cropping system and conservation practices that supplement this system in maintaining productivity and controlling wetness or erosion. These practices depend on the nature of the soil and the intensity of the cropping.

Conservation practices that can be applied on sloping soils are contour stripcropping, terraces, and sod waterways. On sloping, wet soils, surface water can be removed and erosion can be controlled by graded strips, diversions, terraces, and grassed waterways. Subsurface water can generally be removed by random tile lines or open ditches if suitable outlets are available.

Practices to maintain and improve the organic-matter content and soil structure and to reduce erosion include growing winter cover crops, stubble mulching, minimum tillage, and growing green-manure crops. Such practices are needed most if the cropping is intensive or the cultivation is continuous.

Lime and fertilizer should be applied according to soil tests and the need of the crop.

Additional help can be obtained by consulting the local representative of the Soil Conservation Service, the County Extension Service, or the staff of the State Agricultural Experiment Station.

The capability unit descriptions frequently refer to the crops commonly grown in the county. The most commonly grown crops in Tioga County are corn, wheat, oats, alfalfa, red clover, birdsfoot trefoil, timothy, brome, and potatoes.

Soil series are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series are in the unit. The capability unit in which a soil has been placed is listed at the end of the description of that soil.

In the following pages the capability units in Tioga County are described and suggestions for the use and management of the soils are given.

CAPABILITY UNIT I–1

Pope fine sandy loam, high bottom, is the only soil in this unit. It is deep, nearly level, and well drained. It formed in alluvium on flood plains. The surface layer is typically fine sandy loam, but it is sandy loam, loam, or silt loam in places.

Permeability is moderate, and the available water capacity is high. This soil is medium acid to strongly acid. The hazard of erosion is slight.

This soil is suited to all crops grown in the county, and truck crops are well suited. Crop residues and green manure should be returned to the soil to help maintain the content of organic matter and tilth. Cover crops should be grown early in spring and in winter when the hazard of flooding is greatest. Scoured channels should be maintained in grass.

CAPABILITY UNIT IIe–1

This unit consists of gently sloping, deep, well drained Bath, Clymer, and Lackawanna soils. Bath and Lackawanna soils formed in glacial till, and Clymer soils formed in material that weathered from sandstone, siltstone, and shale on the uplands. The surface layer is channery silt loam or channery loam.

Permeability is slow in Bath and Lackawanna soils and moderate to moderately rapid in Clymer soils. The available water capacity is moderate. These soils are extremely acid to neutral. The hazard of erosion is moderate.

These soils are easily cultivated and are suited to all crops grown in the county. Conservation practices are needed to slow runoff and control erosion. Returning cover crops, green manure crops, barnyard manure, and crop residue to the soils helps maintain the content of organic matter, improve tilth, and increase infiltration of moisture.

CAPABILITY UNIT IIe–2

This unit consists of gently sloping, moderately deep well drained Dekalb, Lordstown, and Oquaga soils on uplands. Lordstown and Oquaga soils formed in glacial till, and Dekalb soils formed in material that weathered from sandstone and some shale. The surface layer is channery loam.

Permeability is moderate in Lordstown and Oquaga soils and rapid in Dekalb soils. The available water capacity is moderate to low. These soils are extremely acid to medium acid. The hazard of erosion is moderate.

These soils are easily cultivated and are suited to all crops grown in the county. In some years crops are damaged because they lack adequate moisture. Conservation practices are needed to slow runoff, conserve moisture and control erosion. Returning cover crops, barnyard manure, and crop residue to the soil helps maintain the content of organic matter, improve tilth, and increase infiltration of moisture.

CAPABILITY UNIT IIw–1

This unit consists of nearly level, deep, well drained Pope soils and moderately well drained Philo soils on flood plains. These soils formed in alluvium.

Permeability is moderate, and the available water capacity is high. These soils are very strongly acid to medium acid. The hazard of erosion is slight.

These soils are suited to all crops grown in the county. Cover crops should be grown in winter and early in spring when the hazard of flooding is greatest. Scoured channels should be maintained in grass. Artificial drainage lowers the seasonal high water table in Philo soils.

CAPABILITY UNIT IIw–2

This unit consists of nearly level and gently sloping, deep, moderately well drained Braceville, Mardin, and Wellsboro soils. Mardin and Wellsboro soils formed in glacial till on the uplands, and Braceville soils formed in water-sorted glacial material on terraces.

Permeability is moderately slow to slow, and the available water capacity is moderate. These soils are very strongly acid to neutral. The hazard of erosion is slight to moderate.

These soils are suited to most crops in the county except deep-rooted legumes. Artificial drainage increases the suitability for crops. Conservation practices are needed on the more sloping soils to control erosion.

CAPABILITY UNIT IIs–1

Chenango gravelly loam, 2 to 12 percent slopes, is the only soil in this unit. This is a deep and well drained to somewhat excessively drained soil that formed in water-sorted sand and gravel on terraces.

Permeability is moderate to rapid, and the available water capacity is low. This soil is very strongly acid to strongly acid. The hazard of erosion is slight.

This soil is suited to all crops grown in the county. In most growing seasons, crops are damaged because they lack adequate moisture. Conservation practices are needed to conserve moisture and control runoff. Returning cover crops, barnyard manure, and crop residue to the soil helps maintain the content of organic matter and increase infiltration of moisture.

CAPABILITY UNIT IIIe–1

This capability unit consists of sloping, deep, well drained to somewhat excessively drained Chenango and Lackawanna soils on terraces and the uplands. Chenango soils formed in water-sorted sand and gravel and Lackawanna soils formed in glacial till. The surface layer is gravelly or channery loam.

Permeability is moderate to rapid in Chenango soils and slow in Lackawanna soils. The available water capacity is low to moderate. These soils are very strongly acid to neutral. The hazard of erosion is moderate to high.

These soils are suited to most crops grown in the county. Conservation practices are needed to slow runoff, reduce erosion, and conserve moisture. Addition of organic material, such as barnyard manure, helps maintain the content of organic matter, improve tilth, and increase infiltration of moisture.

CAPABILITY UNIT IIIe–2

This unit consists of sloping, deep, moderately well drained Mardin and Wellsboro soils on the uplands. These soils formed in glacial till. The surface layer is channery loam or channery silt loam.

Permeability is slow, and the available water capacity is moderate. These soils are very strongly acid to neutral. The hazard of erosion is moderate to high.

These soils are suited to most crops grown in the county. Deep-rooted legumes are not well suited because there is a seasonal high water table. Conservation practices are needed to maintain the content of organic matter, control erosion, and reduce runoff. Artificial drainage increases the suitability of the soils for crops.

CAPABILITY UNIT IIIe–3

This unit consists of sloping, moderately deep, well drained Dekalb, Lordstown, and Oquaga soils on the uplands. Dekalb soils formed in material that weathered from sandstone and some shale, and Lordstown and Oquaga soils formed in glacial till. The surface layer is channery loam.

Permability is moderate in Lordstown and Oquaga soils and rapid in Dekalb soils. The available water capacity is low to moderate. These soils are extremely acid to medium acid. The hazard of erosion is moderate to high.

These soils are suited to most crops grown in the county. In some growing seasons, crops are damaged if they lack adequate moisture. Conservation practices are needed to control runoff, reduce erosion, conserve moisture, and maintain the content of organic matter.

CAPABILITY UNIT IIIe-4

This unit consists of sloping, deep, somewhat poorly drained Morris and Volusia soils. These soils formed in glacial till on the uplands. The surface layer is channery or gravelly silt loam.

Permeability is slow to very slow, and the available water capacity is moderate. These soils are very strongly acid to strongly acid. The hazard of erosion is moderate.

These soils are suited to most crops grown in the county except deep-rooted legumes. Conservation practices are needed to control erosion, reduce runoff, improve tilth, and maintain the content of organic matter. Artificial drainage lowers the seasonal high water table and increases the suitability of the soils for crops.

CAPABILITY UNIT IIIe-5

Arnot channery loam, 3 to 12 percent slopes, is the only soil in this unit. This is a shallow and well drained soil that formed in glacial till.

Permeability is moderate to rapid, and the available water capacity is very low. This soil is very strongly acid to strongly acid. The hazard of erosion is moderate.

This soil is suited to some crops grown in the county. In all but the wettest growing seasons, crops are damaged because they lack adequate moisture. Conservation practices are needed to control erosion, reduce runoff, conserve moisture, and maintain the content of organic matter.

CAPABILITY UNIT IIIw-1

Carlisle silt loam is the only soil in this unit. This is a deep, nearly level, very poorly drained soil on flood plains and in depressions. It formed in organic material derived from sedges, cattails, and leaves.

Permeability is moderately rapid, and the available water capacity is high. The soil is very strongly acid to medium acid. The hazard of erosion is slight.

This soil is suited to most crops grown in the county and to truck crops if it is drained and the water level is controlled. Outlets are difficult to obtain, and drainage systems must be maintained. Conservation practices are needed to reduce soil loss from soil blowing. If the soil is not drained, it is best suited to wildlife habitat and nature preserves.

CAPABILITY UNIT IIIw-2

Orrville silt loam is the only soil in this unit. This is a deep, nearly level, somewhat poorly drained soil on flood plains. It formed in alluvium.

Permeability is moderate, and the available water capacity is high. The soil is strongly acid to neutral. The hazard of erosion is slight.

This soil is suited to most crops grown in the county except deep-rooted legumes. Artificial drainage increases the suitability of the soil for crops, but outlets are difficult to obtain. Cover crops should be grown in winter and early in spring to reduce the damage from flooding. Conservation practices are needed to maintain the content of organic matter.

CAPABILITY UNIT IIIw-3

This unit consists of nearly level and sloping, deep, somewhat poorly drained to poorly drained Morris, Rexford, and Volusia soils. Rexford soils formed in water-sorted material on terraces, and Morris and Volusia soils formed in glacial till on the upland. The surface layer is silt loam or channery silt loam.

Permeability is slow to very slow, and the available water capacity is moderate. These soils are very strongly acid to slightly acid. The hazard of erosion is slight to moderate.

These soils are suited to most crops grown in the county except deep-rooted legumes. Artificial drainage lowers the water table and increases the suitability of the soils for crops. Conservation practices are needed to improve tilth and maintain the content of organic matter. Erosion control is needed on the more sloping soils.

CAPABILITY UNIT IVe-1

This unit consists of moderately steep, deep, well drained to somewhat excessively drained Chenango and Wyoming soils. These soils formed in water-sorted material on terraces. The surface layer is gravelly loam or gravelly sandy loam.

Permeability is moderate to rapid, and the available water capacity is low. These soils are very strongly acid to medium acid. The hazard of erosion is high.

These soils are best suited to crops that require limited tillage. In most growing seasons, crops are damaged because they lack adequate moisture. Conservation practices are needed to reduce runoff, control moisture, maintain the content of organic matter, and improve infiltration of moisture.

CAPABILITY UNIT IVe-2

This unit consists of moderately steep, deep, moderately well drained Mardin and Wellsboro soils. These soils formed in glacial till on the uplands. The surface layer is channery silt loam or channery loam.

Permeability is slow, and the available water capacity is moderate. These soils are very strongly acid to medium acid. The hazard of erosion is high.

These soils are best suited to crops that require limited tillage and are tolerant of some wetness. Conservation practices are needed to control erosion, reduce runoff, and maintain the content of organic matter. Artificial drainage increases the suitability of the soils for crops.

CAPABILITY UNIT IVe-3

This unit consists of moderately steep, moderately deep, well drained Lordstown and Oquaga soils. These soils formed in glacial till on the uplands. The surface layer is channery loam.

Permeability is moderate, and the available water capacity is low to moderate. These soils are very strongly acid to medium acid. The hazard of erosion is high.

These soils are best suited to drought-resistant crops that require limited tillage. Conservation practices are needed to control erosion, reduce runoff, maintain the content of organic matter, improve infiltration of moisture, and conserve moisture.

CAPABILITY UNIT IVe–4

This unit consists of moderately steep, deep, somewhat poorly drained Morris and Volusia soils. These soils formed in glacial till on the uplands. The surface layer is channery or gravelly silt loam.

Permeability is slow to very slow, and the available water capacity is moderate. These soils are very strongly acid to medium acid. The hazard of erosion is high.

These soils are best suited to water-tolerant crops that require limited tillage. Conservation practices are needed to reduce runoff, control erosion, and maintain the content of organic matter. Artificial drainage increases the suitability of the soils for crops.

CAPABILITY UNIT IVw–1

Wyoming gravelly loam, flooded, is the only soil in this unit. It is a deep, nearly level, somewhat excessively drained soil on flood plains. This soil formed in water-sorted sand and gravel.

Permeability is rapid, and the available water capacity is low. This soil is very strongly acid to medium acid. The hazard of erosion is slight.

This soil is suited to all crops grown in the county. In most growing seasons, crops are damaged because they lack adequate moisture. Conservation practices are needed to conserve moisture and increase infiltration of moisture. Cover crops should be grown to protect the soil from scouring during flooding.

CAPABILITY UNIT IVw–2

This unit consists of gently sloping and sloping, deep, poorly drained and somewhat poorly drained Kanona soils. These soils formed in glacial till on the uplands. The surface layer is silt loam.

Permeability is slow, and the available water capacity is moderate. These soils are strongly acid to medium acid. The hazard of erosion is moderate.

These soils are suited to most crops grown in the county except deep-rooted legumes. Artificial drainage increases their suitability for crops. Conservation practices are needed to control erosion and maintain the content of organic matter.

CAPABILITY UNIT IVw–3

This unit consists of nearly level and gently sloping, poorly drained and very poorly drained Chippewa, Norwich, and Wayland soils. Chippewa and Norwich soils formed in glacial till on the uplands, and Wayland soils formed in alluvium on flood plains. The surface layer is silt loam or silty clay loam.

Permeability is slow to very slow, and the available water capacity is moderate to high. These soils are strongly acid to neutral. The hazard of erosion is slight.

These soils are best suited to water-tolerant crops. Artificial drainage and interception of inflow from higher lying areas lower the water table and increase the suitability of the soils for crops.

CAPABILITY UNIT IVs–1

Wyoming gravelly sandy loam, 12 to 20 percent slopes, is the only soil in this unit. It is a deep and somewhat excessively drained soil on terraces. This soil formed in water-sorted sand and gravel.

Permeability is rapid, and the available water capacity is low. This soil is very strongly acid to medium acid. The hazard of erosion is moderate.

This soil is suited to all crops grown in the county. In most growing seasons, crops are damaged because they lack adequate moisture. Conservation practices are needed to conserve moisture, increase infiltration of moisture, reduce runoff, and control erosion.

CAPABILITY UNIT VIe–1

This unit consists of eroded, moderately steep, deep, somewhat poorly drained to poorly drained Volusia and Kanona soils. These soils formed in glacial till on the uplands. The surface layer is channery silt loam or silty clay loam.

Permeability is very slow to slow, and the available water capacity is moderate. These soils are very strongly acid to medium acid. The hazard of erosion is high.

These soils are not suited to cultivated crops. They are best suited to woodland or pasture. Conservation practices are needed to maintain adequate cover and prevent erosion.

CAPABILITY UNIT VIw–1

Only Alluvial land is in this unit. This miscellaneous area is deep, nearly level to gently sloping, and well drained to very poorly drained. It is on flood plains.

Because Alluvial land is subject to damage from stream overflow, it is best suited to pasture, woodland, or wildlife habitat. It is not suited to cultivated crops. Careful management is required for any use.

CAPABILITY UNIT VIs–1

This unit consists of very stony, nearly level to moderately steep, deep and moderately deep, well drained to moderately well drained Bath, Clymer, Cookport, Lordstown, Mardin, Oquaga, and Wellsboro soils. These soils formed in glacial till and material that weathered from sandstone and some shale.

These soils are generally too stony to be suited to cultivated crops or improved pasture. They are best suited to woodland or wildlife habitat. Careful management is necessary.

CAPABILITY UNIT VIIe–1

Wyoming gravelly sandy loam, 30 to 50 percent slopes, is the only soil in this unit. It is a deep and somewhat excessively drained soil on terraces. This soil formed in water-sorted sand and gravel.

This soil is too steep and droughty for cultivated crops or pasture. It is best suited to woodland or wildlife habitat. Woodlots need protection from fire and from grazing by cattle.

CAPABILITY UNIT VIIe–2

Volusia channery silt loam, 25 to 35 percent slopes, eroded, is the only soil in this unit. This is a deep and somewhat poorly drained soil that formed in glacial till on the uplands.

This soil is too steep and eroded for cultivated crops and pasture. It is best suited to woodland or wildlife habitat. Woodlots need protection from fire and from grazing cattle to prevent erosion.

CAPABILITY UNIT VIIs–1

This unit consists of very stony to extremely stony, nearly level to moderately steep, deep, somewhat poorly drained Chippewa, Morris, Norwich, and Volusia soils. These soils formed in glacial till on the uplands.

These soils are too stony and wet for cultivated crops or pasture. They are best suited to woodland or wildlife habitat. For best results woodlots should be protected from fire and from grazing by cattle.

CAPABILITY UNIT VIIs–2

This unit consists of extremely stony and rocky, gently sloping to moderately steep, moderately deep to shallow, well drained Dekalb and Arnot soils. These soils formed in material that weathered from sandstone and from glacial till on the uplands.

These soils are too stony and rocky for cultivated crops or pasture. They are best suited to woodland and wildlife habitat. Woodlots should be protected from grazing by cattle and from fire.

CAPABILITY UNIT VIIs–3

This unit consists of extremely stony and rocky, steep and very steep, moderately deep and shallow, well drained Dekalb, Oquaga, and Lordstown soils. These soils formed in glacial till and in material that weathered from sandstone on the uplands.

These soils are too steep and too rocky or too stony for cultivation or pasture. They are best suited to woodland, wildlife habitat, and nature preserves. They need to be protected from fire.

CAPABILITY UNIT VIIIs–1

Only Stony land, wet, is in this unit. This miscellaneous area is wet throughout the year. It is 50 to 90 percent covered by stones.

This land is too wet and stony for cultivated crops or pasture. It is best suited to wildlife habitat. Generally trees are of poor quality and quantity. Protection from fire is needed.

Estimated yields

Table 2 shows the estimated yields for representative field and specialty crops grown in the county and for pasture. These predictions are average for a period of 10 years or more.

The predicted yields are given under two levels of management. In column A are yields to be expected under the normal or prevailing management used in the county. In column B are yields that can be obtained when improved management is practiced. The improved management indicated in column B is based on the assumption that farmers use most of the adapted crop varieties and that fertilization rates and insect and disease control measures are those currently recommended. Management practices are applied at the proper time and at the greatest effectiveness. Soil and water conservation practices are followed, such as minimum tillage, contour tillage, stripcropping, crop residue management, the use of drainage diversions or waterways, or other practices recommended by the Agricultural Extension Service and the Soil Conservation Service. These yields are not for irrigated soils. The yields in column B are not intended to be the maximum yields obtainable. They vary for different soils, but they generally represent an increase over the present average yields for the county. It is expected that yields, especially at the B level, will increase 10 to 25 percent by 1985, as a result of the development of new varieties and improved technology. Yields increased approximately 2 percent a year in Pennsylvania during the 1960's.

Woodland [3]

Tioga County originally had a dense cover of trees. However, clearing for housing and farming and commercial cutting eliminated all of the virgin stands of timber. Now the commercial woodland, which makes up 70 percent of the county, consists of second- and third-growth stands.

The principal forest cover types that make up the woodland of Tioga County and the proportionate extent of each (*6*) are as follows—

About 51 percent of the commercial woodland in Tioga County is maple-beech-birch type forest. Sugar maple, red maple, beech, and yellow birch are dominant, but basswood, hemlock, northern red oak, ash, white pine, and black birch are mixed in the stands.

About 22 percent is aspen-birch type forest. Quaking aspen, bigtooth aspen, and white birch are dominant, but red maple, yellow birch, white pine, ash, and sugar maple occur in the stands.

About 21 percent is mixed oak type forest. White oak, red oak, and chestnut oak are dominant, but white ash, red maple, and beech are also in the stands.

About 6 percent is mixed white pine-hemlock type forest. The stands are about 50 percent white pine and hemlock, and the rest is northern red oak and white oak.

Farmers own 19 percent of the commercial woodland. Other private sources own 53 percent, forest industry 4 percent, Pennsylvania Game Commission 4 percent, and the Pennsylvania Department of Environmental Resources, Bureau of Forestry, 20 percent.

Sawtimber makes up approximately 33 percent of the acreage in commercial forests, poletimber 42 percent, seedlings and saplings 23 percent, and the rest is classified as nonstocked (*6*).

In general, the soils in this county are capable of supporting a good growth of black cherry, ash, red oak, sugar maple, and yellow-poplar. Trees grow slowly on the shallow soils and on the deep, very poorly drained soils.

The more desirable trees grow if good management is used. The soils and the climate are favorable, and help in planning a program of woodland improvement can be obtained from the local offices of the Soil Conservation Service and Pennsylvania Department of Environmental Resources, Bureau of Forestry.

About 56 percent of the existing woodland in the county is growing on soils which are excellent, very good, and good woodland sites. Other woodland acreage is classified as follows: 43 percent is fair sites and 1 percent poor sites.

[3] By V. C. MILES, woodland specialist, Soil Conservation Service.

TABLE 2.—*Estimated yields per*

[In columns A are yields for average management, and in columns B are yields for improved

Soil	Corn [1]		Oats		Wheat	
	A	B	A	B	A	B
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*
Alluvial land						
Arnot channery loam, 3 to 12 percent slopes	30	60	40	55		
Bath channery silt loam, 3 to 12 percent slopes	65	105	60	75	35	45
Bath very stony loam, 3 to 12 percent slopes						
Braceville gravelly loam, 3 to 8 percent slopes	60	95	60	75	30	40
Carlisle silt loam		120				
Chenango gravelly loam, 2 to 12 percent slopes	60	100	60	80	35	45
Chenango gravelly loam, 12 to 20 percent slopes	55	90	55	75	30	40
Chenango gravelly loam, 20 to 30 percent slopes	50	80	50	65	25	35
Chippewa silt loam, 0 to 3 percent slopes		70				
Chippewa silt loam, 3 to 8 percent slopes		70				
Clymer channery loam, 3 to 12 percent slopes	65	110	60	75	40	50
Clymer very stony loam, 3 to 12 percent slopes						
Cookport very stony loam, 0 to 8 percent slopes						
Dekalb channery loam, 3 to 12 percent slopes	50	85	55	70	30	40
Dekalb channery loam, 12 to 20 percent slopes	45	80	50	65	25	35
Kanona silt loam, 3 to 8 percent slopes	35	80	40	55		
Kanona silt loam, 8 to 15 percent slopes	35	75	40	55		
Kanona silty clay loam, 15 to 25 percent slopes, eroded						
Lackawanna channery loam, 3 to 12 percent slopes	65	105	60	75	35	45
Lackawanna channery loam, 12 to 20 percent slopes	60	95	55	75	35	45
Lordstown channery loam, 3 to 12 percent slopes	50	85	55	75	30	45
Lordstown channery loam, 12 to 20 percent slopes	45	85	50	70	25	40
Lordstown channery loam, 20 to 30 percent slopes	40	80	45	65	20	35
Lordstown very stony loam, 3 to 12 percent slopes						
Lordstown very stony loam, 12 to 30 percent slopes						
Mardin channery silt loam, 0 to 3 percent slopes	60	90	60	70	30	40
Mardin channery silt loam, 3 to 8 percent slopes	60	90	60	70	30	40
Mardin channery silt loam, 8 to 15 percent slopes	55	85	55	65	30	40
Mardin channery silt loam, 15 to 25 percent slopes	50	80	50	65	25	35
Mardin very stony silt loam, 0 to 8 percent slopes						
Mardin very stony silt loam, 8 to 25 percent slopes						
Morris gravelly silt loam, 0 to 3 percent slopes	50	80	50	65		
Morris gravelly silt loam, 3 to 8 percent slopes	50	80	50	65		
Morris gravelly silt loam, 8 to 15 percent slopes	45	70	45	60		
Morris gravelly silt loam, 15 to 25 percent slopes	40	65	40	60		
Norwich silt loam		70				
Oquaga channery loam, 3 to 12 percent slopes	50	85	55	75	30	45
Oquaga channery loam, 12 to 20 percent slopes	45	85	50	70	25	40
Oquaga channery loam, 20 to 30 percent slopes	40	80	45	65	20	35
Oquaga very stony loam, 3 to 12 percent slopes						
Oquaga very stony loam, 12 to 30 percent slopes						
Orrville silt loam	65	100	50	60		
Philo silt loam	95	130	65	75	30	40
Pope soils	100	135	70	80	35	45
Pope fine sandy loam, high bottom	105	135	70	80	40	45
Rexford silt loam, 0 to 3 percent slopes	50	80	50	65		35
Rexford silt loam, 3 to 10 percent slopes	50	80	50	65		35
Volusia channery silt loam, 0 to 3 percent slopes	50	80	50	65		
Volusia channery silt loam, 3 to 8 percent slopes	50	80	50	65		
Volusia channery silt loam, 8 to 15 percent slopes	45	70	45	60		
Volusia channery silt loam, 15 to 25 percent slopes	40	65	40	60		
Volusia channery silt loam, 15 to 25 percent slopes, eroded						
Volusia channery silt loam, silty substratum, 3 to 8 percent slopes	50	80	50	65		
Volusia channery silt loam, silty substratum, 8 to 15 percent slopes	45	70	45	60		
Volusia channery silt loam, silty substratum, 15 to 25 percent slopes, eroded						
Wayland silty clay loam		100		70		
Wellsboro channery loam, 0 to 3 percent slopes	60	90	60	70	30	40
Wellsboro channery loam, 3 to 8 percent slopes	60	90	60	70	30	40
Wellsboro channery loam, 8 to 15 percent slopes	55	85	55	65	30	40

See footnotes at end of table.

acre of field and forage crops

management. The absence of data indicates that the soil is not suited to that crop]

Potatoes		Alfalfa-grass mixture		Grass-legume mixture		Pasture			
						Bluegrass		Tall grass	
A	B	A	B	A	B	A	B	A	B
Bu	*Bu*	*Tons*	*Tons*	*Tons*	*Tons*	*AUM* [2]	*AUM* [2]	*AUM* [2]	*AUM* [2]
						3.5	5.0		
		1.0	2.0	1.0	1.5	1.3	2.3	1.7	3.8
400	500	2.3	4.0	1.8	3.5	2.3	5.3	3.8	7.6
						2.0	4.5		
400	550	2.1	4.0	1.7	3.0	2.3	4.5	3.5	7.6
	600								
400	500	2.3	4.5	1.8	3.5	2.3	5.3	3.8	8.5
		2.3	4.5	1.8	3.5	2.3	5.3	3.8	8.5
		2.2	4.0	1.7	3.0	2.3	4.5	3.7	7.6
				1.0	2.5	1.3	3.8	1.7	4.8
				1.0	2.5	1.3	3.8	1.7	4.8
400	550	2.4	4.0	1.9	3.5	2.5	5.3	4.0	7.6
						2.0	4.5		
						1.8	4.0		
300	400	2.3	3.5	1.6	3.0	2.2	4.2	3.8	6.7
		2.2	3.0	1.5	2.5	2.0	3.8	3.7	6.5
				1.2	2.5	1.7	3.8	2.0	4.8
				1.2	2.5	1.7	3.8	2.0	4.8
						1.5	3.2		
400	500	2.3	4.0	1.8	3.5	2.3	5.3	3.9	7.6
		2.3	4.0	1.8	3.5	2.3	5.3	3.9	7.6
300	435	2.3	3.5	1.8	3.0	2.3	4.5	3.9	6.7
		2.2	3.5	1.5	3.0	2.0	4.5	3.7	6.7
		1.9	3.0	1.4	3.0	1.8	4.5	3.2	5.7
						1.8	3.7		
						1.5	3.7		
350	450	2.1	4.0	1.7	3.0	2.3	4.5	3.5	7.6
350	450	2.1	4.0	1.7	3.0	2.3	4.5	3.5	7.6
		2.0	4.0	1.7	3.0	2.3	4.5	3.5	7.6
		2.0	3.5	1.6	3.0	2.2	4.5	3.3	6.7
						1.8	3.7		
						1.7	3.5		
	400	1.4	3.0	1.5	3.0	2.0	4.5	2.3	5.7
	400	1.4	3.0	1.5	3.0	2.0	4.5	2.3	5.7
		1.4	3.0	1.5	3.0	2.0	4.5	2.3	5.7
		1.3	2.5	1.4	2.5	1.7	3.8	2.1	4.8
				.9	2.5	1.2	3.5	1.5	4.8
300	435	2.3	3.5	1.8	3.0	2.3	4.5	3.9	6.7
		2.2	3.5	1.5	3.0	2.0	4.5	3.7	6.7
		1.9	3.0	1.4	3.0	1.8	4.5	3.2	5.7
						1.8	3.7		
						1.5	3.5		
				2.3	3.5	3.0	5.3	3.7	6.7
400	600	3.0	4.0	2.6	3.5	3.5	5.3	5.0	8.5
450	600	3.5	4.5	2.7	3.5	3.6	5.3	5.5	8.5
500	650	3.5	4.5	2.7	3.5	3.6	5.3	5.8	8.5
		1.4	3.0	1.5	3.0	2.0	4.3	2.3	5.7
		1.4	3.0	1.5	3.0	2.0	4.3	2.3	5.7
	400	1.4	3.0	1.5	3.0	2.0	4.3	2.3	5.7
	400	1.4	3.0	1.5	3.0	2.0	4.3	2.3	5.7
		1.4	3.0	1.5	3.0	2.0	4.3	2.3	5.7
		1.3	2.5	1.4	2.5	1.8	3.8	2.2	4.8
						1.5	3.0		
	400	1.4	3.0	1.5	3.0	2.0	4.3	2.3	5.7
		1.4	3.0	1.5	3.0	2.0	4.3	2.3	5.7
						1.5	3.0		
				2.0	3.5	3.2	5.3	2.5	6.7
400	500	2.1	4.0	1.7	3.0	2.3	4.5	3.5	7.6
400	500	2.1	4.0	1.7	3.0	2.3	4.5	3.5	7.6
		2.0	4.0	1.7	3.0	2.3	4.5	3.5	7.6

TABLE 2.—*Estimated yields per acre*

Soil	Corn [1]		Oats		Wheat	
	A	B	A	B	A	B
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*
Wellsboro channery loam, 15 to 25 percent slopes	50	80	50	65	25	35
Wellsboro very stony loam, 0 to 8 percent slopes						
Wellsboro very stony loam, 8 to 25 percent slopes						
Wyoming gravelly sandy loam, 12 to 20 percent slopes	50	75	55	70	25	35
Wyoming gravelly sandy loam, 20 to 30 percent slopes	50	70	50	65	20	30
Wyoming gravelly loam, flooded	60	90	60	75	30	40

[1] The bushels per acre yield can be converted to tons per acre of silage when divided by 5. For example, 120 bushels equal 24 tons of silage.

Table 3 gives each soil a rating as to management problems and hazards, plant suitability, and site quality for producing timber.

Erosion hazard depends on the amount or intensity of practices required to reduce or control erosion on the different soils. A rating of *slight* indicates that the risk of erosion is low when wood products are harvested, and that few, if any, practices are needed to control erosion. A rating of *moderate* indicates that erosion control is needed on skid and logging roads immediately after wood products are harvested. If the rating is *severe,* it means that erosion, especially gullying, is a severe hazard when wood products are harvested. Harvesting and other operations should be done across the slope as much as possible. Skid trails and logging roads should be laid out on as low grades as possible, and water-disposal systems should be carefully maintained during logging. Erosion control is needed on logging roads and skid trails immediately after logging.

Equipment limitations are based on the characteristics of the soils and topographic features that restrict or prohibit the use of equipment for harvesting trees or planting seedlings. Steepness of slope, stoniness, and wetness are the principal soil limitations that restrict the use of equipment. The rating is *slight* if there are few limitations. It is *moderate* if some problems exist, such as stones and boulders, moderately steep slopes, or wetness of the soil part of the year. The rating is *severe* if prolonged wetness of the soil, steepness, or stoniness severely limit the use of equipment. If the rating is severe, track-type equipment is best for general use, and winches or similar special equipment are needed for some kinds of work.

Seedling mortality refers to the loss of naturally occurring or planted tree seedlings resulting from unfavorable characteristics of the soils. The rating is *slight* if no more than 25 percent of the planted seedlings are likely to die and satisfactory restocking from the initial planting can be expected. Adequate restocking ordinarily results from natural regeneration. A rating of *moderate* indicates that between 25 and 50 percent of planted seedlings are likely to die, and some replanting is ordinarily needed. Natural regeneration cannot always be relied upon for adequate and early restocking. A rating of *severe* indicates that more than 50 percent of planted seedlings are likely to die, and special preparation of the seedbed, superior planting techniques, and considerable replanting are needed for adequate and immediate restocking. Restocking cannot be expected to result from natural regeneration if the rating for seedling mortality is severe.

Plant competition refers to the rate at which brush, grass, and undesirable trees are likely to invade the different kinds of soil. Plant competition is *slight* if unwanted plants do not prevent adequate natural regeneration and early growth or interfere with adequate development of planted seedlings. It is *moderate* if competing plants delay natural or artificial regeneration, both establishment and growth, but do not prevent the natural development of a fully stocked normal stand. Competition is *severe* if adequate natural or artificial regeneration can be obtained only by intensive site preparation and maintenance, including weeding.

Windthrow hazard depends on the factors that control the development of tree roots and, consequently, the likelihood that trees will be uprooted by wind. A rating of *slight* indicates that normally no trees are blown down by the wind. A rating of *moderate* indicates that some trees are expected to be blown down during periods of excessive soil wetness and high wind. If the rating is *severe,* many trees are expected to be blown down during periods of soil wetness and moderate or high winds.

Suitable trees means that the trees listed in table 3 are recommended because they are well suited to the site and generally have good economic value. In planning the development of an existing woods, it would be advisable to review the list of trees. The objectives of the landowner will determine which species to favor when plantations are to be started. The trees listed

of field and forage crops—Continued

Potatoes		Alfalfa-grass mixture		Grass-legume mixture		Pasture			
						Bluegrass		Tall grass	
A	B	A	B	A	B	A	B	A	B
Bu	*Bu*	*Tons*	*Tons*	*Tons*	*Tons*	*AUM* [2]	*AUM* [2]	*AUM* [2]	*AUM* [2]
		2.0	3.5	1.6	3.0	2.2	4.5	3.3	6.7
						1.8	3.7		
						1.7	3.5		
		2.2	3.5	1.1	2.5	1.5	3.8	3.3	6.6
		2.0	3.5	1.1	2.5	1.5	3.8	3.3	6.6
		2.0	3.5	1.7	3.0	2.3	4.5	3.3	6.7

[2] AUM is animal-unit-month, a term used to express the carrying capacity of pasture. It is the number of animal units per acre a pasture can carry each month without injury to the sod. An acre of pasture that provides 1 month of grazing for one cow or horse, 5 hogs, or 7 sheep has a carrying capacity of 1 animal-unit-month.

under "for planting or seeding" are recommended as the best for these particular soils.

Site quality indicates the general ability of these soils to produce timber. The ratings are based on sample plots located within the county and adjacent counties. Other soils in the county that have characteristics similar to those of the soils studied, were assumed to have about the same rating. The ratings for oak are based on data by G. L. Schnur (*7*). The site class is based on the site index, or average height attained by the dominant and co-dominant trees at the age of 50 years. Foresters using this rating can determine the volume of timber that normal stands will produce at different ages.

If the site class for oak is rated *excellent*, the site index is 85 or better, and the expected yield at age 50 is 13,750 or more board feet per acre (Published data for oak do not go beyond site index 80) (International rule). If the rating is *very good*, the site index is 75 to 84 and the expected yield at age 50 is about 13,750 board feet per acre. If the rating is *good*, the site index is 65 to 74 and the expected yield at age 50 is about 9,750 board feet per acre. A rating of *fair* means the site index is 55 to 64, and the expected yield at age 50 is 6,300 board feet per acre. A rating of *poor* means a site index of less than 54 and an expected yield at age 50 of less than 3,250 board feet per acre.

The ratings for yellow-poplar are based on data recorded by E. F. McCarthy of the Central States Experiment Station. An *excellent* rating means that the site index is 95 or better and the expected yield at age 50 is 32,150 board feet per acre. *Very good* means that the site index is 85–95 and the expected yield at age 50 is about 24,400 board feet per acre; good, site index is 75–85 and the expected yield is 17,620 board feet per acre; fair, site index is 65–75 and the expected yield is 11,400 board feet per acre; poor, site index is 55–65 and the expected yield is 5,600 board feet per acre.

The site classes for other trees, such as white pine, sugar maple, ash, and black cherry vary somewhat, but the taller trees of the same species are in the better site classes at age 50 and then decrease accordingly. Information on site classes for other trees can be obtained from the USDA Soil Conservation Service and the Pennsylvania Department of Environmental Resources, Bureau of Forestry.

The returns from soils that are excellent, very good, and good growing sites generally justify the expenditure of money for management purposes. However, consideration should be given to the potential yield, quality of the particular trees growing on the site, and the market potential. The kind of trees and proportion of poor quality stems growing on such sites may prohibit the investment of money for management purposes. Also, the conversion of such areas from their present use may not be economically justifiable.

Soils that are fair growing sites are the most difficult to appraise for management. A thorough appraisal of the kind and quality of trees on the site is essential. Also, the market possibility should be investigated. A proper analysis of all of these factors is essential to determine the intensity of management to be used.

The returns from the soils that are poor growing sites seldom justify management for the production of wood products, but woodland is, in most cases, the most practical use for these soils. Because of unfavorable soil characteristics, these soils generally do not show a profitable return in crops or grasses.

Wildlife [4]

Many kinds of wildlife, fish, and songbirds are in Tioga County. The soils, topography, and patterns of land use are favorable for increasing the kinds and numbers of these species.

All soils are capable of supporting some wildlife, and every kind of soil is generally occupied by several wildlife species. In planning land use, the soils that are most suitable for crops and have the highest economic

[4] CLAYTON L. HEINEY, JR., wildlife biologist, Soil Conservation Service, helped prepare this section.

TABLE 3.—*Woodland*

[Interpretations were not made for Carlisle silt loam (CA), the Rock outcrop parts of ArB and OVF, and

Soils and map symbols	Erosion hazard	Equipment limitations	Seedling mortality	Plant competition	
				Conifers	Hardwoods
Alluvial land: Ab	Moderate	Slight	Slight	Severe	Moderate
Arnot:					
AoB	Slight	Slight	Severe	Slight	Slight
ArB	Slight	Moderate	Severe	Slight	Slight
Bath: BaB, BsB	Slight	Slight	Slight	Moderate	Slight
Braceville: BvB	Slight	Slight	Slight	Severe	Moderate
Chenango:					
ChB, ChC	Slight	Slight	Moderate	Severe	Moderate
ChD	Slight	Moderate	Moderate	Severe	Moderate
Chippewa: CkA, CkB, ClB	Slight	Severe	Severe	Moderate	Moderate
Clymer: CmB, CsB	Slight	Slight	Slight	Severe	Moderate
Cookport: CvB	Slight	Slight	Slight	Severe	Moderate
Dekalb:					
DkB, DkC	Slight	Slight	Moderate	Slight	Slight
DsB	Slight	Moderate	Severe	Slight	Slight
DsD	Moderate	Moderate	Severe	Slight	Slight
DsF	Moderate	Severe	Severe	Slight	Slight
Kanona:					
KaB	Slight	Severe	Severe	Moderate	Moderate
KaC	Moderate	Severe	Severe	Moderate	Moderate
KcD3	Severe	Severe	Severe	Moderate	Moderate
Lackawanna: LaB, LaC	Slight	Slight	Slight	Moderate	Slight
Lordstown:					
LoB, LoC	Slight	Slight	Moderate	Moderate	Slight
LoD	Moderate	Moderate	Moderate	Moderate	Slight
LsB	Slight	Slight	Moderate	Moderate	Slight
LsD	Moderate	Moderate	Moderate	Moderate	Slight

See footnote at end of table.

potential of the soils

Stony land, wet (Sw), because the areas are too variable to evaluate and need onsite investigation]

Windthrow hazard	Suitable trees—		Site quality	
	To favor existing stands	For planting or seeding	Kinds of trees	Site class
Slight	Red oak, ash, sugar maple, black cherry, sycamore.	Larch, Norway spruce, white pine.	Red oak,[1] sugar maple, black cherry, ash.	Good.
Moderate	Red oak, black oak, red maple, white pine.	Red pine, white pine, larch	Red oak, black oak,[1] red maple	Fair.
Moderate	Red oak, black oak, red maple, white pine.	Red pine, white pine, larch	Red oak, black oak,[1] red maple	Fair.
Slight	Red oak, ash, sugar maple, black cherry.	White pine, larch, red pine, Norway spruce, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Good.
Slight	Red oak, ash, sugar maple, black cherry.	Red pine, white pine, larch, Norway spruce, black cherry.	Red oak,[1] ash, sugar maple	Very good.
Slight	Red oak, ash, sugar maple, black cherry.	White pine, larch, Norway spruce, red pine, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Very good.
Slight	Red oak, black oak, ash, sugar maple, black cherry.	Larch, red pine, Norway spruce, red pine, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Very good.
Severe	Red oak, sugar maple, ash	White pine, white spruce	Red oak,[1] ash, sugar maple	Poor.
Slight	Red oak, black oak, ash, sugar maple, black cherry.	Larch, red pine, Norway spruce, black cherry, white pine.	Red oak,[1] black oak, ash, sugar maple, black cherry.	Very good.
Slight	Red oak, ash, sugar maple, black cherry.	Black cherry, larch, Norway spruce, white pine.	Red oak,[1] ash, sugar maple, black cherry.	Very good.
Slight	Red oak, black oak, chestnut oak, red maple.	Red pine, white pine, pitch pine.	Red oak,[1] black oak, chestnut oak, red maple.	Poor.
Slight	Red oak, black oak, chestnut oak, red maple.	Red pine, white pine, pitch pine.	Red oak,[1] black oak, chestnut oak, red maple.	Poor.
Slight	Red oak, black oak, chestnut oak, red maple.	Red pine, white pine, pitch pine.	Red oak,[1] black oak, chestnut oak, red maple.	Poor.
Slight	Red oak, black oak, chestnut oak, red maple.	Red pine, white pine, pitch pine.	Red oak,[1] black oak, chestnut oak, red maple.	Poor.
Severe	Red oak, red maple	White pine, white spruce	Red oak,[1] red maple	Fair.
Severe	Red oak, red maple	White pine, white spruce	Red oak,[1] red maple	Fair.
Severe	Red oak, red maple	White pine, white spruce	Red oak,[1] red maple	Fair.
Slight	Red oak, black oak, ash, sugar maple, black cherry.	White pine, larch, Norway spruce, red pine.	Red oak,[1] black oak, ash, black cherry, sugar maple.	Good.
Slight	Red oak, ash, sugar maple, black cherry.	White pine, larch, Norway spruce, red pine, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Good.
Slight	Red oak, ash, sugar maple, black cherry.	White pine, larch, Norway spruce, red pine, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Good.
Slight	Red oak, ash, sugar maple, black cherry.	White pine, larch, Norway spruce, red pine, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Good.
Slight	Red oak, ash, sugar maple, black cherry.	White pine, larch, Norway spruce, red pine, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Good.

TABLE 3.—*Woodland potential*

Soils and map symbols	Erosion hazard	Equipment limitations	Seedling mortality	Plant competition	
				Conifers	Hardwoods
Mardin: MaA, MaB, MaC	Slight	Slight	Slight	Slight	Slight
MaD	Slight	Moderate	Slight	Moderate	Slight
MdB	Slight	Slight	Slight	Slight	Slight
MdD	Slight	Moderate	Slight	Moderate	Slight
Morris: MoA, MoB, MoC	Slight	Moderate	Moderate	Severe	Severe
MoD	Moderate	Moderate	Moderate	Severe	Severe
MsB	Slight	Moderate	Moderate	Severe	Moderate
MsD	Moderate	Moderate	Moderate	Severe	Moderate
Norwich: No, Ns	Slight	Severe	Severe	Severe	Severe
Oquaga: OgB, OgC	Slight	Slight	Moderate	Moderate	Slight
OgD	Slight	Moderate	Moderate	Moderate	Slight
OsB	Slight	Slight	Moderate	Moderate	Slight
OsD	Slight	Moderate	Moderate	Moderate	Slight
OTF, OVF	Moderate	Severe	Moderate	Moderate	Slight
Orrville: Ow	Slight	Severe	Slight	Severe	Severe
Philo: Ph	Slight	Slight	Slight	Severe	Moderate
Pope: Po, Pp	Slight	Slight	Slight	Severe	Moderate
Rexford: RxA, RxB	Slight	Moderate	Moderate	Severe	Moderate
Volusia: VoA, VoB, VoC, VvB, VvC	Slight	Moderate	Moderate	Severe	Moderate
VoD, VoD3, VoE3, VvD3	Moderate	Moderate	Moderate	Severe	Moderate

See footnote at end of table.

of the soils—Continued

Windthrow hazard	Suitable trees—		Site quality	
	To favor existing stands	For planting or seeding	Kinds of trees	Site class
Slight	Red oak, ash, sugar maple, black cherry.	Red pine, white pine, larch, Norway spruce, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Fair.
Slight	Red oak, ash, sugar maple, black cherry.	Red pine, white pine, larch, Norway spruce, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Fair.
Slight	Red oak, ash, sugar maple, black cherry.	Red pine, white pine, larch, Norway spruce, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Fair.
Slight	Red oak, ash, sugar maple, black cherry.	Red pine, white pine, larch, Norway spruce, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Fair.
Moderate	Red oak, ash, sugar maple, red maple, black cherry.	Larch, white pine, Norway spruce, white spruce, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Moderate	Red oak, ash, sugar maple, red maple, black cherry.	Larch, white pine, Norway spruce, white spruce, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Moderate	Red oak, ash, sugar maple, red maple, black cherry.	Larch, white pine, Norway spruce, white spruce, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Moderate	Red oak, ash, sugar maple, red maple, black cherry.	Larch, white pine, Norway spruce, white spruce, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Severe	Red maple, sycamore	White pine, white spruce	Red maple[1]	Poor.
Slight	Red oak, ash, sugar maple, black cherry.	Larch, Norway spruce, red pine, white pine, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Slight	Red oak, ash, sugar maple, black cherry.	Larch, Norway spruce, red pine, white pine, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Slight	Red oak, ash, sugar maple, black cherry.	Larch, Norway spruce, red pine, white pine, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Slight	Red oak, ash, sugar maple, black cherry.	Larch, Norway spruce, red pine, white pine, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Slight	Red oak, ash, sugar maple, black cherry.	Larch, Norway spruce, red pine, white pine, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Moderate	Red maple, red oak, sycamore	White pine, white spruce	Red maple[1]	Very good.
Slight	Red oak, ash, sugar maple, black cherry, white pine.	Black cherry, larch, Norway spruce, white pine.	Red oak,[1] ash, sugar maple, black cherry.	Excellent.
Slight	Red oak, ash, sugar maple, black cherry, white pine.	Black cherry, larch, Norway spruce, white pine.	Red oak,[1] ash, sugar maple, black cherry.	Excellent.
Moderate	Red oak, ash, sugar maple, black cherry.	Black cherry, larch, Norway spruce, white spruce, white pine.	Red oak,[1] ash, sugar maple, black cherry.	Good.
Moderate	Red oak, ash, sugar maple, black cherry.	Larch, Norway spruce, white spruce, white pine, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Moderate	Red oak, ash, sugar maple, black cherry.	Larch, Norway spruce, white spruce, white pine, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.

TABLE 3.—*Woodland potential*

Soils and map symbols	Erosion hazard	Equipment limitations	Seedling mortality	Plant competition	
				Conifers	Hardwoods
VsB	Slight	Moderate	Moderate	Severe	Moderate
VsD	Moderate	Moderate	Moderate	Severe	Moderate
VtB	Slight	Severe	Moderate	Severe	Moderate
Wayland: Wa	Slight	Severe	Severe	Severe	Severe
Wellsboro:					
WeA, WeB, WeC	Slight	Slight	Slight	Moderate	Slight
WeD	Slight	Moderate	Slight	Moderate	Slight
WsB	Slight	Slight	Slight	Moderate	Slight
WsD	Slight	Moderate	Slight	Moderate	Slight
Wyoming:					
WyC	Slight	Slight	Severe	Slight	Slight
WyD, WyF	Slight	Moderate	Severe	Slight	Slight
Wz	Slight	Slight	Moderate	Severe	Moderate

[1] The site class rating is based on this kind of tree.

value are generally not used exclusively for wildlife. Soils that are used mainly for wildlife are most often those that have severe limitations for cultivation.

The kind and abundance of wildlife depend, to a large extent, on the type of habitat available. An area is inhabited by the kinds of wildlife that are satisfied by the plants in it. The plant cover, in turn, depends to a great extent upon the kind of soils. If natural conditions are altered by drainage, cultivation, or other practices used in managing crops or woodland, the kinds and patterns of vegetation change and the kinds and numbers of wildlife also change.

The soils in Tioga County can be used for development of suitable wildlife habitat in the form of woodland, parks, hunting preserves, and refuges. In addition, the streams, lakes and reservoirs have potential for greater use.

The following paragraphs describe the major kinds of wildlife in Tioga County. The associations referred to are described in the section "General Soil Map." The location of each is shown on the general soil map in the back of this survey.

White-tailed deer are the most abundant large animals in the county. Tioga County is one of the leading counties in the state for deer production. They are generally considered a forest species, but they prefer areas of brush or young trees and open areas. They are generally throughout the county, but the greatest concentration is north of the Cowanesque River on the Volusia-Mardin-Lordstown association and the Oquaga-Lordstown association. A smaller concentration is in the southeastern part of the county on the Volusia-Mardin-Lordstown association and the Morris-Oquaga-Wellsboro association.

Black bear are common in Tioga County. They are found throughout the mountainous areas of the Lordstown-Mardin association, on the Oquaga-Lordstown association, and on the Dekalb-Clymer association.

Cottontail rabbits are abundant in the county. They are most abundant in the brushy areas of the Volusia-Mardin-Lordstown association, on the Morris-Oquaga-Wellsboro association, and on the Oquaga-Morris association. Rabbits prefer brushy areas interspersed with crops and grass. Their habitat can be improved by cutting back vegetation along the borders of wooded areas and planting grasses and legumes.

Gray squirrels are common along the edges of the Lordstown-Mardin association and in areas of the Oquaga-Lordstown association where mature oak and beech are plentiful. Squirrels prefer woodland interspersed with crops.

Ruffed grouse are generally most plentiful on the Morris-Oquaga-Wellsboro association and the Oquaga-Morris association, but smaller numbers are found

of the soils—Continued

Windthrow hazard	Suitable trees—		Site quality	
	To favor existing stands	For planting or seeding	Kinds of trees	Site class
Moderate	Red oak, ash, sugar maple, black cherry.	Larch, Norway spruce, white spruce, white pine, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Moderate	Red oak, ash, sugar maple, black cherry.	Larch, Norway spruce, white spruce, white pine, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Moderate	Red oak, ash, sugar maple, black cherry.	Larch, Norway spruce, white spruce, white pine, black cherry.	Red oak,[1] ash, sugar maple, red maple, black cherry.	Good.
Severe	Red oak, red maple, sycamore	White pine, white spruce	Red maple[1]	Poor.
Slight	Red oak, ash, sugar maple, black cherry.	Red pine, white pine, larch, Norway spruce, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Very good.
Slight	Red oak, ash, sugar maple, black cherry.	Red pine, white pine, larch, Norway spruce, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Very good.
Slight	Red oak, ash, sugar maple, black cherry.	Red pine, white pine, larch, Norway spruce, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Very good.
Slight	Red oak, ash, sugar maple, black cherry.	Red pine, white pine, larch, Norway spruce, black cherry.	Red oak,[1] ash, sugar maple, black cherry.	Very good.
Slight	Red oak, black oak, red maple	White pine, red maple	Red oak,[1] black oak, red maple	Poor.
Slight	Red oak, black oak, red maple	White pine, red maple	Red oak,[1] black oak, red maple	Poor.
Slight	Red oak, black oak, red maple	White pine, red maple	Red oak,[1] black oak, red maple	Poor.

throughout the county. They prefer brushy stands of young trees, preferably aspen, and open areas.

Wild turkeys are very plentiful. They are most common on the Lordstown-Mardin association and the Oquaga-Lordstown association. Turkeys prefer mature forests that produce mast, but they feed in open brushy areas and cultivated fields during summer.

Woodcock are plentiful on wet soils. These birds nest on the Pope-Chenango-Orrville association and the Volusia-Mardin-Lordstown association. They feed where the soils are wet and aspen is dominant. The population increases during the fall migration.

Woodchucks are very common on the Volusia-Mardin-Lordstown association, Morris-Oquaga-Wellsboro association, and Oquaga-Morris association. They prefer open areas of grasses and legumes. Areas that have large fence rows or small brushy areas adjacent to hayfields afford excellent cover close to feeding areas.

Muskrats and beaver are the principal fur-bearing animals in the county. Muskrats are found in marshy areas and along small streams and farm ponds. Beaver are found, to some extent, along the banks of some of the larger streams in the county. Many beaver are found where they have dammed up wet areas, small streams, and stream heads throughout the county.

Waterfowl, mainly mallards and wood ducks, nest along the streams, marshes, farm ponds, and lakes in the county. Many species of ducks and Canadian geese stop to rest and feed on lakes and ponds during migration to other parts of the country.

Fishing in Tioga County is excellent. Brook trout, rainbow trout, and brown trout inhabit all unpolluted streams. Bluegill, largemouth bass, yellow perch, pickerel, and muskellunge thrive in the ponds and lakes in the county.

Soil suitability is one of the important factors for the production of desired populations of wildlife. Other important factors are present land use and existing wildlife populations. The latter two require onsite investigation for their evaluation. Soil interpretations should be used along with other types of information to study resource suitability for the production of wildlife.

Every kind of wildlife depends on certain types of soil, vegetation, and water for food and cover. The proper manipulation of these elements of habitat is the most effective means of maintaining and improving the wildlife population. If the properties of soils are known, it is possible to predict their suitability to produce the habitat elements essential for wildlife.

In table 4, the soils of Tioga County are rated according to their suitability for the essential elements of wildlife habitat and types of habitat. The ratings are based on a modification of a system proposed by P.

TABLE 4.—*Potential of the soils*

Soil series and map symbols	Potential for habitat elements			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees
Alluvial land: Ab. Too variable to rate.				
Arnot:				
AoB	Very poor	Poor	Poor	Very poor
ArB	Very poor	Very poor	Poor	Very poor
Bath:				
BaB	Fair	Good	Good	Good
BsB	Very poor	Poor	Good	Good
Braceville: BvB	Fair	Good	Good	Good
Carlisle: CA	Very poor	Very poor	Very poor	Very poor
Chenango:				
ChB	Poor	Fair	Good	Fair
ChC	Poor	Fair	Good	Fair
ChD	Poor	Fair	Good	Fair
Chippewa:				
CkA	Poor	Fair	Fair	Good
CkB, ClB	Poor	Fair	Fair	Good
Clymer: CmB, CsB	Fair	Good	Good	Good
Cookport: CvB	Very poor	Poor	Good	Good
Dekalb:				
DkB	Fair	Good	Fair	Poor
DkC	Poor	Fair	Fair	Poor
DsB, DsD	Very poor	Very poor	Fair	Poor
DsF	Very poor	Very poor	Fair	Poor
Kanona:				
KaB	Poor	Fair	Fair	Fair
KaC, KcD3	Poor	Fair	Fair	Fair
Lackawanna:				
LaB	Fair	Good	Good	Good
LaC	Poor	Fair	Good	Good
Lordstown:				
LoB	Poor	Fair	Fair	Poor
LoC	Poor	Fair	Fair	Poor
LoD	Very poor	Poor	Fair	Poor
LsB	Very poor	Poor	Fair	Poor
LsD	Very poor	Poor	Fair	Poor
Mardin:				
MaA	Good	Good	Good	Good
MaB	Good	Good	Good	Good
MaC	Fair	Good	Good	Good
MaD	Poor	Fair	Good	Good
MdB	Very poor	Poor	Good	Good
MdD	Very poor	Poor	Good	Good
Morris:				
MoA	Fair	Good	Good	Good
MoB	Fair	Good	Good	Good
MoC	Fair	Good	Good	Good
MoD	Poor	Fair	Good	Good
MsB	Very poor	Poor	Good	Good
MsD	Very poor	Poor	Good	Good
Norwich:				
No, Ns	Very poor	Poor	Poor	Poor

for wildlife habitat

Potential for habitat elements—Continued			Potential as habitat for—		
Coniferous plants	Wetland plants	Shallow-water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Very poor	Poor	Very poor	Poor	Very poor	Very poor.
Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Poor	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Very poor	Good	Good	Very poor	Very poor	Good.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Good	Good	Good	Fair	Good	Good.
Good	Poor	Very poor	Fair	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Poor	Good	Very poor.
Poor	Very poor	Very poor	Fair	Good	Very poor.
Poor	Very poor	Very poor	Fair	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Fair	Poor	Very poor	Fair	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Poor	Very poor	Very poor	Fair	Poor	Very poor.
Poor	Very poor	Very poor	Fair	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Poor	Good	Very poor.
Good	Very poor	Very poor	Poor	Good	Very poor.
Good	Fair	Fair	Good	Good	Fair.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Poor	Good	Very poor.
Good	Very poor	Very poor	Poor	Good	Very poor.
Poor	Good	Good	Poor	Poor	Good.

TABLE 4.—*Potential of the soils*

Soil series and map symbols	Potential for habitat elements			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees
Oquaga:				
OgB	Poor	Fair	Fair	Poor
OgC	Poor	Fair	Fair	Poor
OgD	Very poor	Fair	Fair	Poor
OsB, OsD	Very poor	Poor	Fair	Poor
OTF, OVF	Very poor	Very poor	Fair	Very poor
Orrville: Ow	Poor	Fair	Fair	Fair
Philo: Ph	Good	Good	Good	Good
Pope: Po, Pp	Good	Good	Good	Good
Rexford:				
RxA	Fair	Good	Good	Good
RxB	Fair	Good	Good	Good
Stony land, wet: Sw	Very poor	Very poor	Very poor	Very poor
Volusia:				
VoA	Fair	Good	Good	Good
VoB	Fair	Good	Good	Good
VoC	Fair	Good	Good	Good
VoD, VoD3	Poor	Fair	Good	Good
VoE3	Very poor	Fair	Good	Good
VsB	Very poor	Poor	Good	Good
VsD	Very poor	Poor	Good	Good
VtB	Very poor	Very poor	Good	Good
VvB	Fair	Good	Good	Good
VvC	Fair	Good	Good	Good
VvD3	Poor	Fair	Good	Good
Wayland: Wa	Very poor	Poor	Poor	Poor
Wellsboro:				
WeA	Good	Good	Good	Good
WeB	Good	Good	Good	Good
WeC	Fair	Good	Good	Good
WeD	Poor	Fair	Good	Good
WsB	Very poor	Poor	Good	Good
WsD	Very poor	Poor	Good	Good
Wyoming:				
WyC	Poor	Fair	Fair	Poor
WyD	Very poor	Fair	Fair	Poor
WyF	Very poor	Very poor	Fair	Poor
Wz	Fair	Good	Good	Fair

F. Allan and others (*1*). Each rating reflects only the characteristics of the individual, unmodified soil. The categories rated in table 4 are described in the following paragraphs:

Grain and seed crops.—Domestic grain and seed-producing annual plants such as corn, wheat, and millet.

Grasses and legumes.—Domestic perennial grasses and herbaceous legumes such as timothy, alfalfa, and reed canarygrass.

Wild herbaceous plants.—Wild grasses and weeds such as goldenrod and pokeweed.

Hardwood trees.—Deciduous trees, shrubs, and vines such as oak, dogwood, grapes, and briers.

Coniferous plants.—Cone-bearing trees and shrubs such as pines, cedars, and yews.

Wetland plants.—Wild herbaceous plants common in moist to wet sites, except submerged and floating aquatic plants. Included are plants such as smartweeds, bulrushes, reed canarygrass, and cattails.

Shallow water areas.—Shallow water areas no more than 5 feet deep that are either natural or created by low dikes, level ditches, and water control devices on marshy streams.

Openland wildlife.—Cultivated fields, pasture, meadow, and areas overgrown with grasses, herbs, vines, or shrubby plants. Such areas provide habitat

for wildlife habitat—Continued

Potential for habitat elements—Continued			Potential as habitat for—		
Coniferous plants	Wetland plants	Shallow-water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Poor	Very poor	Very poor	Fair	Poor	Very poor.
Poor	Very poor	Very poor	Fair	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Very poor	Very poor	Very poor	Poor	Very poor	Very poor.
Fair	Good	Good	Fair	Fair	Good.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Fair	Fair	Good	Good	Fair.
Good	Poor	Poor	Good	Good	Poor.
Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Good	Fair	Fair	Good	Good	Fair.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Poor	Good	Very poor.
Good	Very poor	Very poor	Poor	Good	Very poor.
Good	Poor	Very poor	Poor	Fair	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Poor	Good	Very poor.
Good	Very poor	Very poor	Poor	Good	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.

for quail, pheasant, dove, woodcock, cottontail rabbit, meadowlark, killdeer, and field sparrow.

Woodland wildlife.—Areas of either hardwood or coniferous trees and shrubs or combinations of both. Such areas provide habitat for grouse, turkey, deer, squirrel, wood thrushes, warblers, and vireos.

Wetland wildlife.—Marshes, swamps, and open-water areas. Such areas provide habitat for duck, geese, rail, snipe, muskrat, and beaver.

The ratings shown in table 4 indicate the suitability of the soil to produce various habitat elements and kinds of habitat. A rating of *good* indicates that habitat generally is easily created, improved, or maintained. The soil has few limitations to management, and satisfactory results can be expected.

A rating of *fair* indicates that habitat is fairly easy to create, improve, or maintain. Moderate soil limitations affect management. Moderate intensity of management and frequent attention may be required for satisfactory results.

A rating of *poor* indicates that habitat generally is more difficult to create, improve, or maintain. Severe soil limitations affect management and can make habitat difficult and expensive to maintain. Results are questionable.

A rating of *very poor* indicates that under prevailing

soil conditions, it is impractical to create, improve, or maintain habitat. Unsatisfactory results are probable.

It should be noted that the ratings indicate only potential suitability for wildlife habitat. Changes in land use may modify the environment enough to cause it to attract different kinds of wildlife. Also, the ability of wildlife to move from place to place and to utilize more than one kind of habitat is not considered in making the ratings.

Community Planning

This section of the soil survey provides information on the properties of the soils and their effect on selected uses of soils in community planning. It will help community planners, developers, and individual land owners determine the most suitable use for a particular area. Other useful information can be found on the soil map and in other parts of the survey, particularly "Description of the Soils" and "Engineering." Although the soil map and tables serve as a guide and can eliminate some sites from further consideration, they do not supplant onsite investigation. Not considered in rating the soils are location in relation to established business centers or transportation lines and other economic factors that are important in determining the ultimate use of an area.

Soil limitations in table 5 are indicated by the ratings slight, moderate, and severe. *Slight* means soil properties are generally favorable for the rated use, or limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means soil properties so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special design, or intensive maintenance.

Following are explanations of the columns in table 5.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a property that affects difficulty of layout and construction and also the risk of erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic-matter content, and slope, and if the floor needs to be leveled, depth to and condition of bedrock becomes important. The properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified soil classification and properties that influence the ease of excavation and compaction of the embankment material, such as the amount of stones, if any, in the material.

Dwellings with basement as rated in table 5 are homesites or other buildings of three stories or less that have no more than an 8-foot excavation for basements. Considered in rating the soils are the depth to water table, shrink-swell potential, the depth to and the kind of bedrock, texture, slope, potential frost action, and the hazard of flooding.

Lawns and landscaping for homesites require suitable soil material in sufficient quantities so that desirable trees and other plants can survive and grow well. It is assumed that enough lime and fertilizer are used for lawn grasses and ornamental plants to grow. Among the important soil properties are depth to bedrock or to layers that restrict water and roots, texture, slope, depth to water table, and stoniness or rockiness.

Local roads and streets have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material and also the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and the amount of cut and fill needed to reach an even grade.

Sanitary landfill is a method of disposing of refuse. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some properties that affect suitability for landfill are ease of excavation, hazard of polluting groundwater, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated the ratings in table 5 apply only to soil material to a depth of about 6 feet, and therefore ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. For some soils, reliable predictions can be made to a depth of 10 to 15 feet, but every site should be investigated before it is selected.

Recreation Development

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 6 the soils of Tioga County are rated according to limitations that affect their use as campsites, service buildings, paths and trails, picnic areas, playgrounds, and golf fairways.

In table 6 the soils are rated as having slight, moderate, or severe limitations for the specified uses. For all these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they can easily be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these, is required.

Campsites are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required other than shaping and leveling for tent and parking areas. Campsites are subject to heavy foot traffic and limited vehicular traffic. The best soils for campsites have mild slopes, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rain but not dusty when dry.

Service buildings and dwellings without a basement are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the use of a soil for service buildings are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, content of stones, and outcroppings of bedrock.

Paths and trails are used for local and cross-country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded no more than once during the season of use, have slope of less than 15 percent, and have few or no rocks or stones on the surface.

Picnic areas are attractive natural or landscaped areas used mainly for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry, are free of flooding during the season of use, and do not have slopes or stoniness that greatly increase the cost of leveling sites or of building access roads.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and outcroppings of rock, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rain but not dusty when dry. If grading and leveling are required, depth to rock is important.

Golf fairways are used intensively and are subject to heavy foot traffic. Most of the vehicular traffic is confined to hard surface trails and roads. The best soils have good drainage, mild slopes, and a surface that is free of rocks and stones and that is firm after rain but not dusty when dry.

Engineering [5]

This section is useful to planning commissions, town and city managers, land developers, engineers, contractors, farmers, and others who need information about soils used as structural material or as foundation on which structures are built.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the soils on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables. Table 7 shows estimated soil properties significant in engineering. Table 8 gives interpretations for various engineering uses. Table 9 shows the results of engineering laboratory tests on soil samples.

This information, along with the soil map and data in other parts of this publication, can be used to make interpretations in addition to those given in tables 7 and 8, and it also can be used to make useful maps.

This information, however, does not eliminate the need for further investigation at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil can include small areas of other kinds of soil that have strongly contrasting properties and different suitability or limitations for soil engineering.

Some of the terms used in this soil survey have

[5] JOHN K. ROBB, engineer, Soil Conservation Service, helped prepare this section.

TABLE 5.—*Suitability of the soils*

Soil series and map symbols	Septic tank absorption fields	Sewage lagoons	Dwellings with basement
Alluvial land: Ab	Severe: flooding; high water table.	Severe: flooding; high water table.	Severe: flooding; high water table.
Arnot:			
AoB	Severe: bedrock at a depth of 1 foot to 1½ feet; rocky.	Severe: bedrock at a depth of 1 foot to 1½ feet.	Severe: bedrock at a depth of 1 foot to 1½ feet.
ArB	Severe: bedrock at a depth of 1 foot to 1½ feet.	Severe: bedrock at a depth of 1 foot to 1½ feet; rocky.	Severe: bedrock at a depth of 1 foot to 1½ feet; rocky.
Bath:			
BaB	Severe: slow permeability	Moderate: channery	Slight
BsB	Severe: slow permeability	Moderate: channery	Moderate: stony
Braceville: BvB	Severe: seasonal high water table; moderately slow permeability.	Severe: permeable substratum.	Moderate: seasonal high water table.
Carlisle: CA	Severe: high water table	Severe: high water table	Severe: high water table
Chenango:			
ChB	Slight: hazard of ground water contamination.	Severe: rapid permeability	Slight
ChC	Moderate: slope; hazard of ground water contamination.	Severe: rapid permeability; slope.	Moderate: slope
ChD	Severe: slope	Severe: rapid permeability; slope.	Severe: slope
Chippewa:			
CkA	Severe: high water table; very slow permeability.	Moderate: channery; inflow hazard.	Severe: high water table
CkB, ClB	Severe: high water table; very slow permeability.	Moderate: channery; inflow hazard; slope.	Severe: high water table
Clymer:			
CmB	Moderate: bedrock at a depth of 3½ to 7 feet.	Severe: moderately rapid permeability.	Slight
CsB	Moderate: bedrock at a depth of 3½ to 7 feet.	Severe: moderately rapid permeability.	Moderate: stony
Cookport: CvB	Severe: seasonal high water table; slow permeability.	Moderate: bedrock at a depth of 3½ to 4 feet; inflow hazard.	Moderate: seasonal high water table; stony.
DeKalb:			
DkB	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet; rapid permeability.	Moderate: bedrock at a depth of 1½ to 3½ feet.
DkC	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet; rapid permeability; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.
DsB	Severe: bedrock at a depth of 1½ to 3½ feet; stony.	Severe: bedrock at a depth of 1½ to 3½ feet; rapid permeability.	Severe: stony
DsD	Severe: bedrock at a depth of 1½ to 3½ feet; stony; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; rapid permeability; slope.	Severe: stony; slope
DsF	Severe: bedrock at a depth of 1½ to 3½ feet; stony; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; rapid permeability; slope.	Severe: stony; slope
Kanona:			
KaB	Severe: high water table; slow permeability.	Moderate: bedrock at a depth of 3½ to 5 feet; inflow hazard.	Severe: high water table

for community planning

Lawns and landscaping	Local roads and streets	Sanitary landfill (trench-type)
Severe: flooding; high water table	Severe: flooding; high water table	Severe: flooding; high water table
Severe: bedrock at a depth of 1 foot to 1½ feet.	Severe: bedrock at a depth of 1 foot to 1½ feet.	Severe: bedrock at a depth of 1 foot to 1½ feet.
Severe: bedrock at a depth of 1 foot to 1½ feet; rocky.	Severe: bedrock at a depth of 1 foot to 1½ feet.	Severe: bedrock at a depth of 1 foot to 1½ feet; rocky.
Slight	Slight	Slight.
Moderate: stony	Slight	Moderate: stony.
Moderate: seasonal high water table	Moderate: seasonal high water table; frost action.	Severe: seasonal high water table; pervious substratum.
Severe: high water table	Severe: high water table	Severe: high water table.
Slight	Slight	Severe: rapid permeability.
Moderate: slope	Moderate: slope	Severe: rapid permeability.
Severe: slope	Severe: slope	Severe: rapid permeability.
Severe: high water table	Severe: high water table; frost action	Severe: high water table.
Severe: high water table	Severe: high water table; frost action	Severe: high water table.
Slight	Slight	Severe: moderately rapid permeability.
Moderate: stony	Slight	Severe: moderately rapid permeability.
Moderate: stony	Slight	Severe: seasonal high water table; bedrock at a depth of 3½ to 4 feet.
Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Severe: rapid permeability.
Moderate: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: rapid permeability.
Severe: stony	Moderate: bedrock at a depth of 1½ to 3½ feet; stony.	Severe: rapid permeability; stony.
Severe: stony; slope	Severe: slope	Severe: rapid permeability; stony.
Severe: stony; slope	Severe: slope	Severe: rapid permeability; stony; slope.
Severe: high water table	Severe: high water table; frost action	Severe: high water table.

TABLE 5.—*Suitability of the soils*

Soil series and map symbols	Septic tank absorption fields	Sewage lagoons	Dwellings with basement
KaC	Severe: high water table; slow permeability.	Severe: slope	Severe: high water table
KcD3	Severe: high water table; slow permeability; slope.	Severe: slope	Severe: high water table; slope.
Lackawanna:			
LaB	Severe: slow permeability	Moderate: channery; slope	Slight
LaC	Severe: slow permeability	Severe: slope	Moderate: slope
Lordstown:			
LoB	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
LoC	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.
LoD	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: slope
LsB	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet; stony.
LsD	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: slope
Mardin:			
MaA	Severe: seasonal high water table; slow permeability.	Moderate: channery	Moderate: seasonal high water table.
MaB	Severe: seasonal high water table; slow permeability.	Moderate: channery; slope	Moderate: seasonal high water table.
MaC	Severe: seasonal high water table; slow permeability.	Severe: slope	Moderate: seasonal high water table; slope.
MaD	Severe: seasonal high water table; slow permeability; slope.	Severe: slope	Severe: slope
MdB	Severe: seasonal high water table; slow permeability.	Moderate: channery; slope	Moderate: seasonal high water table; stony.
MdD	Severe: seasonal high water table; slow permeability; slope.	Severe: slope	Severe: slope
Morris:			
MoA	Severe: seasonal high water table; slow permeability.	Moderate: gravelly; inflow hazard.	Severe: seasonal high water table.
MoB	Severe: seasonal high water table; slow permeability.	Moderate: gravelly; inflow hazard; slope.	Severe: seasonal high water table.
MoC	Severe: seasonal high water table; slow permeability.	Severe: slope	Severe: seasonal high water table.
MoD	Severe: seasonal high water table; slow permeability; slope.	Severe: slope	Severe: seasonal high water table; slope.
MsB	Severe: seasonal high water table; slow permeability.	Moderate: gravelly; inflow hazard; slope.	Severe: seasonal high water table.
MsD	Severe: seasonal high water table; slow permeability; slope.	Severe: slope	Severe: seasonal high water table; slope.
Norwich: No, Ns	Severe: high water table; slow permeability.	Moderate: gravelly; inflow hazard.	Severe: high water table

for community planning—Continued

Lawns and landscaping	Local roads and streets	Sanitary landfill (trench-type)
Severe: high water table	Severe: high water table; frost action	Severe: high water table.
Severe: high water table; slope	Severe: high water table; frost action; slope.	Severe: high water table.
Slight	Slight	Slight.
Moderate: slope	Moderate: slope	Slight.
Moderate: bedrock at a depth of 1½ to 3½ feet.	Slight	Moderate: bedrock at a depth of 1½ to 3½ feet.
Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: slope	Moderate: bedrock at a depth of 1½ to 3½ feet.
Severe: slope	Severe: slope	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.
Moderate: bedrock at a depth of 1½ to 3½ feet; stony.	Slight	Moderate: bedrock at a depth of 1½ to 3½ feet.
Severe: slope	Severe: slope	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.
Slight	Slight	Severe: seasonal high water table.
Slight	Slight	Severe: seasonal high water table.
Moderate: slope	Moderate: slope	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: seasonal high water table.
Moderate: stony	Slight	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: seasonal high water table.
Moderate: seasonal high water table	Moderate: seasonal high water table; frost action.	Severe: seasonal high water table.
Moderate: seasonal high water table	Moderate: seasonal high water table; frost action.	Severe: seasonal high water table.
Moderate: seasonal high water table; slope.	Moderate: seasonal high water table; frost action; slope.	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: seasonal high water table.
Moderate: seasonal high water table; stony.	Moderate: seasonal high water table; frost action.	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: seasonal high water table.
Severe: high water table	Severe: high water table; frost action	Severe: high water table.

TABLE 5.—*Suitability of the soils*

Soil series and map symbols	Septic tank absorption fields	Sewage lagoons	Dwellings with basement
Oquaga:			
OgB	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
OgC	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.
OgD	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: slope
OsB	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet; stony.
OsD	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: slope
OTF	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: slope
OVF	Severe: bedrock at a depth of 1½ to 3½ feet; rocky; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; rocky; slope.	Severe: slope
Orrville: Ow	Severe: seasonal high water table; flood hazard.	Severe: flood hazard	Severe: flood hazard
Philo: Ph	Severe: seasonal high water table; flood hazard.	Severe: flood hazard	Severe: flood hazard
Pope:			
Po	Severe: flood hazard	Severe: flood hazard	Severe: flood hazard
Pp	Severe: flood hazard	Severe: flood hazard	Severe: flood hazard
Rexford:			
RxA	Severe: seasonal high water table; slow permeability.	Moderate: gravelly; inflow hazard; possibly permeable substratum.	Severe: seasonal high water table.
RxB	Severe: seasonal high water table; slow permeability.	Moderate: gravelly; inflow hazard; slope; possible permeable substratum.	Severe: seasonal high water table.
Stony land, wet: Sw	Severe: high water table; stony.	Severe: high water table; stony.	Severe: high water table; stony.
Volusia:			
VoA	Severe: seasonal high water table; very slow permeability.	Moderate: channery; inflow hazard.	Severe: seasonal high water table.
VoB, VvB	Severe: seasonal high water table; very slow permeability.	Moderate: channery; inflow hazard; slope.	Severe: seasonal high water table.
VoC, VvC	Severe: seasonal high water table; very slow permeability.	Severe: slope	Severe: seasonal high water table.
VoD, VoD3, VvD3	Severe: seasonal high water table; very slow permeability; slope.	Severe: slope	Severe: seasonal high water table; slope.
VoE3	Severe: seasonal high water table; very slow permeability; slope.	Severe: slope	Severe: seasonal high water table; slope.
VsB	Severe: seasonal high water table; very slow permeability.	Moderate: channery; inflow hazard.	Severe: seasonal high water table.
VsD	Severe: seasonal high water table; slow permeability; slope.	Severe: slope	Severe: seasonal high water table; slope.

for community planning—Continued

Lawns and landscaping	Local roads and streets	Sanitary landfill (trench-type)
Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Moderate: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Severe: slope	Severe: slope	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.
Moderate: bedrock at a depth of 1½ to 3½ feet; stony.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Severe: slope	Severe: slope	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.
Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Severe: slope	Severe: slope.
Moderate: flood hazard	Severe: flood hazard; frost action	Severe: seasonal high water table; flood hazard.
Moderate: flood hazard	Severe: flood hazard	Severe: seasonal high water table; flood hazard.
Moderate: flood hazard	Severe: flood hazard	Severe: flood hazard.
Slight	Severe: flood hazard	Severe: flood hazard.
Moderate: seasonal high water table	Moderate: seasonal high water table; frost action.	Severe: seasonal high water table.
Moderate: seasonal high water table	Moderate: seasonal high water table; frost action.	Severe: seasonal high water table.
Severe: high water table; stony	Severe: high water table; stony	Severe: high water table; stony.
Moderate: seasonal high water table	Moderate: seasonal high water table; frost action.	Severe: seasonal high water table.
Moderate: seasonal high water table	Moderate: seasonal high water table; frost action.	Severe: seasonal high water table.
Moderate: seasonal high water table; slope.	Moderate: seasonal high water table; frost action; slope.	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: seasonal high water table; slope.
Moderate: seasonal high water table; stony.	Moderate: seasonal high water table; frost action.	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: seasonal high water table.

TABLE 5.—*Suitability of the soils*

Soil series and map symbols	Septic tank absorption fields	Sewage lagoons	Dwellings with basement
VtB	Severe: seasonal high water table; very slow permeability.	Severe: stony	Severe: seasonal high water table; stony.
Wayland: Wa	Severe: high water table; flood hazard.	Severe: flood hazard	Severe: high water table; flood hazard.
Wellsboro:			
WeA	Severe: seasonal high water table; slow permeability.	Moderate: channery	Moderate: seasonal high water table.
WeB	Severe: seasonal high water table; slow permeability.	Moderate: channery; slope	Moderate: seasonal high water table.
WeC	Severe: seasonal high water table; slow permeability.	Severe: slope	Moderate: seasonal high water table; slope.
WeD	Severe: seasonal high water table; slow permeability; slope.	Severe: slope	Severe: slope
WsB	Severe: seasonal high water table; slow permeability.	Moderate: channery; slope	Moderate: seasonal high water table; stony.
WsD	Severe: seasonal high water table; slow permeability; slope.	Severe: slope	Severe: slope
Wyoming:			
WyC	Moderate: slope; hazard of ground water contamination.	Severe: rapid permeability; very gravelly; slope.	Moderate: slope
WyD	Severe: slope	Severe: rapid permeability; very gravelly; slope.	Severe: slope
WyF	Severe: slope	Severe: rapid permeability; very gravelly; slope.	Severe: slope
Wz	Severe: flood hazard	Severe: rapid permeability; very gravelly; flood hazard.	Severe: flood hazard

special meaning in soil science. The Glossary defines many of these terms.

The Volusia silty substratum soils, VvB, VvC, and VvD3, are underlain at a depth of about 40 inches by glacial lacustrine silt and clay. They are unstable, particularly when disturbed. These soils and the underlying lacustrine deposit present problems for engineering use. Development sites on areas of these soils should be carefully investigated.

In general, stream valleys draining north to the Chemung River and the Pine Creek Valley from Potter County to Ansonia are underlain at varying depths by glacial lacustrine silt and clay. These deposits are most common at elevations of 1,100 to 1,600 feet (*11*).

Classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*3*) used by SCS engineers, the Department of Defense, and others, and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*2*).

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes, for example, CL–ML.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7

for community planning—Continued

Lawns and landscaping	Local roads and streets	Sanitary landfill (trench-type)
Severe: stony	Severe: stony	Severe: seasonal high water table.
Severe: high water table; flood hazard	Severe: high water table; flood hazard; frost action.	Severe: high water table; flood hazard.
Slight	Slight	Severe: seasonal high water table.
Slight	Slight	Severe: seasonal high water table.
Moderate: slope	Moderate: slope	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: seasonal high water table.
Moderate: stony	Slight	Severe: seasonal high water table.
Severe: slope	Severe: slope	Severe: seasonal high water table.
Moderate: too sandy; slope	Moderate: slope	Severe: rapid permeability.
Severe: slope	Severe: slope	Severe: rapid permeability.
Severe: slope	Severe: slope	Severe: rapid permeability; slope.
Moderate: flood hazard	Severe: flood hazard	Severe: rapid permeability; flood hazard.

groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 9; the estimated classification, without group index numbers, is given in table 7 for all soils mapped in the survey area.

Soil properties

Several estimated soil properties significant in engineering are given in table 7. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the column headings in table 7.

Depth to seasonal high water table is distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Depth to bedrock is distance from the surface of the soil to the rock layer.

Soil texture is described in table 7 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used are defined in the Glossary of this soil survey.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 7 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

TABLE 6.—*Soil limitations*

Soil series and map symbols	Campsites	Service buildings and dwellings without basement	Paths and trails
Alluvial land: Ab	Severe: flooding; high water table.	Severe: flooding; high water table.	Severe: high water table
Arnot:			
AoB	Moderate: channery	Severe: bedrock at a depth of 1 foot to 1½ feet.	Moderate: channery
ArB	Moderate: channery; rocky	Severe: bedrock at a depth of 1 foot to 1½ feet.	Moderate: channery
Bath:			
BaB	Moderate: channery; slow permeability.	Slight	Moderate: channery
BsB	Moderate: channery; stony; slow permeability.	Moderate: stony	Moderate: channery; stony
Braceville: BvB	Moderate: gravelly; moderately slow permeability; seasonal high water table.	Moderate: seasonal high water table.	Moderate: gravelly
Carlisle: CA	Severe: high water table	Severe: high water table	Severe: high water table
Chenango:			
ChB	Moderate: gravelly	Slight	Moderate: gravelly
ChC	Moderate: gravelly; slope	Moderate: slope	Moderate: gravelly
ChD	Severe: slope	Severe: slope	Moderate: gravelly; slope
Chippewa: CkA, CkB, ClB	Severe: high water table	Severe: high water table	Severe: high water table
Clymer:			
CmB	Moderate: channery	Slight	Moderate: channery
CsB	Moderate: channery; stony	Moderate: stony	Moderate: channery; stony
Cookport: CvB	Moderate: slow permeability; stony.	Moderate: stony	Moderate: stony
DeKalb:			
DkB	Moderate: channery	Slight	Moderate: channery
DkC	Moderate: channery; slope	Moderate: slope	Moderate: channery
DsB	Severe: stony	Severe: stony	Severe: stony
DsD	Severe: stony; slope	Severe: stony; slope	Severe: stony
DsF	Severe: stony; slope	Severe: stony; slope	Severe: stony; slope
Kanona:			
KaB	Severe: high water table	Severe: high water table	Severe: high water table
KaC	Severe: high water table	Severe: high water table	Severe: high water table
KcD3	Severe: high water table; slope.	Severe: high water table; slope.	Severe: high water table
Lackawanna:			
LaB	Moderate: channery; slow permeability.	Slight	Moderate: channery
LaC	Moderate: channery; slope	Moderate: slope	Moderate: channery
Lordstown:			
LoB	Moderate: channery	Slight	Moderate: channery
LoC	Moderate: channery; slope	Moderate: slope	Moderate: channery

for recreation

Picnic areas	Playgrounds	Golf fairways
Severe: high water table; flooding	Severe: high water table; flooding	Severe: high water table; flooding.
Moderate: channery	Severe: channery; bedrock at a depth of 1 foot to 1½ feet.	Severe: bedrock at a depth of 1 foot to 1½ feet.
Moderate: channery	Severe: channery; bedrock at a depth of 1 foot to 1½ feet; rocky.	Severe: bedrock at a depth of 1 foot to 1½ feet; rocky.
Moderate: channery	Severe: channery	Moderate: channery.
Moderate: channery	Severe: channery	Moderate: channery; stony.
Moderate: gravelly; seasonal high water table.	Severe: gravelly; seasonal high water table.	Moderate: gravelly; seasonal water table.
Severe: high water table	Severe: high water table	Severe: high water table.
Moderate: gravelly	Severe: gravelly	Moderate: gravelly.
Moderate: gravelly; slope	Severe: gravelly; slope	Moderate: gravelly; slope.
Severe: slope	Severe: gravelly; slope	Severe: slope.
Severe: high water table	Severe: high water table	Severe: high water table.
Moderate: channery	Severe: channery	Moderate: channery.
Moderate: channery	Severe: channery	Moderate: channery; stony.
Slight	Moderate: seasonal high water table; slow permeability.	Moderate: stony.
Moderate: channery	Severe: channery	Moderate: channery; bedrock at a depth of 1½ to 3½ feet.
Moderate: channery; slope	Severe: channery; slope	Moderate: channery; bedrock at a depth of 1½ to 3½ feet.
Moderate: stony	Severe: channery; stony	Severe: stony.
Severe: slope	Severe: channery; stony; slope	Severe: stony; slope.
Severe: slope	Severe: channery; stony; slope	Severe: stony; slope.
Severe: high water table	Severe: high water table	Severe: high water table.
Severe: high water table	Severe: high water table; slope	Severe: high water table.
Severe: high water table	Severe: high water table; slope	Severe: high water table; slope.
Moderate: channery	Severe: channery	Moderate: channery; bedrock at a depth of 1½ to 3½ feet.
Moderate: channery; slope	Severe: channery; slope	Severe: channery; slope.
Moderate: channery	Severe: channery	Moderate: channery; bedrock at a depth of 1½ to 3½ feet.
Moderate: channery; slope	Severe: channery; slope	Moderate: channery; bedrock at a depth of 1½ to 3½ feet.

TABLE 6.—*Soil limitations*

Soil series and map symbols	Campsites	Service buildings and dwellings without basement	Paths and trails
LoD	Severe: slope	Severe: slope	Moderate: channery; slope
LsB	Moderate: channery; stony	Moderate: stony	Moderate: channery; stony
LsD	Severe: slope	Severe: slope	Moderate: channery; stony; slope.
Mardin:			
MaA, MaB	Moderate: channery; slow permeability.	Slight	Moderate: channery
MaC	Moderate: channery; slow permeability; slope.	Moderate: slope	Moderate: channery
MaD	Severe: slope	Severe: slope	Moderate: channery; slope
MdB	Moderate: channery; stony; slow permeability.	Moderate: stony	Moderate: channery, stony
MdD	Severe: slope	Severe: slope	Moderate: channery; stony; slope.
Morris:			
MoA, MoB	Moderate: channery; seasonal high water table; slow permeability.	Moderate: seasonal high water table.	Moderate: seasonal high water table; channery.
MoC	Moderate: channery; seasonal high water table; slow permeability; slope.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table; channery.
MoD	Severe: slope	Severe: slope	Moderate: seasonal high water table; channery; slope.
MsB	Moderate: channery; seasonal high water table; slow permeability; stony.	Moderate: seasonal high water table; stony.	Moderate: channery; seasonal high water table; stony.
MsD	Severe: slope	Severe: slope	Moderate: channery; seasonal high water table; stony; slope.
Norwich: No, Ns	Severe: high water table	Severe: high water table	Severe: high water table
Oquaga:			
OgB	Moderate: channery	Slight	Moderate: channery
OgC	Moderate: channery; slope	Moderate: slope	Moderate: channery
OgD	Severe: slope	Severe: slope	Moderate: channery; slope
OsB	Moderate: channery; slope	Moderate: stony	Moderate: channery; stony
OsD	Severe: slope	Severe: slope	Moderate: channery; stony; slope.
OTF	Severe: slope	Severe: slope	Severe: slope
OVF	Severe: slope	Severe: slope	Severe: slope
Orrville: Ow	Moderate: flooding; seasonal high water table.	Severe: flooding	Moderate: seasonal high water table.
Philo: Ph	Moderate: flooding	Severe: flooding	Slight

for recreation—Continued

Picnic areas	Playgrounds	Golf fairways
Severe: slope	Severe: channery; slope	Severe: slope.
Moderate: channery	Severe: channery	Moderate: channery; stony; bedrock at a depth of 1½ to 3½ feet.
Severe: slope	Severe: channery; slope	Severe: slope.
Moderate: channery	Severe: channery	Moderate: channery.
Moderate: channery; slope	Severe: channery; slope	Moderate: channery; slope.
Severe: slope	Severe: channery; slope	Severe: slope.
Moderate: channery	Severe: channery	Moderate: channery; stony.
Severe: slope	Severe: channery; slope	Severe: slope.
Moderate: seasonal high water table; channery.	Severe: channery; seasonal high water table.	Moderate: seasonal high water table; channery.
Moderate: seasonal high water table; channery; slope.	Severe: channery; seasonal high water table; slope.	Moderate: seasonal high water table; channery; slope.
Severe: slope	Severe: channery; seasonal high water table; slope.	Severe: slope.
Moderate: channery; seasonal high water table.	Severe: channery; seasonal high water table.	Moderate: channery; stony.
Severe: slope	Severe: channery; seasonal high water table; slope.	Severe: slope.
Severe: high water table	Severe: high water table	Severe: high water table.
Moderate: channery	Severe: channery	Moderate: channery; bedrock at a depth of 1½ to 3½ feet.
Moderate: channery; slope	Severe: channery; slope	Moderate: channery; bedrock at a depth of 1½ to 3½ feet; slope.
Severe: slope	Severe: channery; slope	Severe: slope.
Moderate: channery	Severe: channery	Moderate: channery; bedrock at a depth of 1½ to 3½ feet; stony.
Severe: slope	Severe: channery; slope	Severe: slope.
Severe: slope	Severe: channery; slope	Severe: slope.
Severe: slope	Severe: channery; slope	Severe: slope.
Moderate: flooding; seasonal high water table.	Severe: seasonal high water table	Moderate: seasonal high water table; flooding.
Moderate: flooding	Moderate: seasonal high water table; flooding.	Moderate: flooding.

TABLE 6.—*Soil limitations*

Soil series and map symbols	Campsites	Service buildings and dwellings without basement	Paths and trails
Pope:			
Po	Moderate: flooding	Severe: flooding	Slight
Pp	Slight	Severe: flooding	Slight
Rexford: RxA, RxB	Severe: high water table	Severe: high water table	Severe: high water table
Stony land, wet: Sw	Severe: high water table; stony.	Severe: high water table; stony.	Severe: high water table; stony.
Volusia:			
VoA, VoB, VvB	Moderate: seasonal high water table; channery; very slow permeability.	Moderate: seasonal high water table.	Moderate: channery; seasonal high water table.
VoC, VvC	Moderate: seasonal high water table; channery; very slow permeability; slope.	Moderate: seasonal high water; slope.	Moderate: channery; seasonal high water table.
VoD, VoD3, VvD3	Severe: slope	Severe: slope	Moderate: channery; seasonal high water table; slope.
VoE3	Severe: slope	Severe: slope	Severe: slope
VsB	Moderate: seasonal high water table; very slow permeability; channery; stony.	Moderate: seasonal high water table; stony.	Moderate: seasonal high water table; channery; stony.
VsD	Severe: slope	Severe: slope	Moderate: seasonal high water table; channery; stony; slope.
VtB	Severe: stony	Severe: stony	Severe: stony
Wayland: Wa	Severe: high water table; flooding.	Severe: high water table; flooding.	Severe: high water table
Wellsboro:			
WeA, WeB	Moderate: channery; slow permeability.	Slight	Moderate: channery
WeC	Moderate: channery; slow permeability; slope.	Moderate: slope	Moderate: channery
WeD	Severe: slope	Severe: slope	Moderate: channery; slope
WsB	Moderate: channery; slow permeability; stony.	Moderate: stony	Moderate: channery; stony
WsD	Severe: slope	Severe: slope	Moderate: channery; stony; slope.
Wyoming:			
WyC	Moderate: gravelly; slope	Moderate: slope	Moderate: gravelly
WyD	Severe: slope	Severe: slope	Moderate: gravelly; slope
WyF	Severe: slope	Severe: slope	Severe: slope
Wz	Moderate: gravelly; flooding.	Severe: flooding	Moderate: gravelly

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Optimum moisture for compaction and maximum dry density are defined in the section "Soil test data."

Shrink-swell potential is the relative change in

for recreation—Continued

Picnic areas	Playgrounds	Golf fairways
Moderate: flooding	Moderate: flooding	Moderate: flooding.
Slight	Slight	Slight.
Severe: high water table	Severe: high water table	Severe: high water table.
Severe: high water table; stony	Severe: high water table; stony	Severe: high water table; stony.
Moderate: channery; seasonal high water table.	Severe: seasonal high water table; channery.	Moderate: channery; seasonal high water table.
Moderate: channery; seasonal high water table; slope.	Severe: seasonal high water table; channery; slope.	Moderate: channery; seasonal high water table; slope.
Severe: slope	Severe: seasonal high water table; channery; slope.	Severe: slope.
Severe: slope	Severe: slope	Severe: slope.
Moderate: seasonal high water table; channery.	Severe: seasonal high water table; channery.	Moderate: seasonal high water table; channery; stony.
Severe: slope	Severe: seasonal high water table; channery; slope.	Severe: slope.
Severe: channery; stony	Severe: seasonal high water table; channery; stony.	Severe: stony.
Severe: high water table	Severe: high water table	Severe: high water table.
Moderate: channery	Severe: channery	Moderate: channery.
Moderate: channery; slope	Severe: channery; slope	Moderate: channery; slope.
Severe: slope	Severe: slope	Severe: slope.
Moderate: channery	Severe: channery	Moderate: channery; stony.
Severe: slope	Severe: channery; slope	Severe: slope.
Moderate: gravelly; slope	Severe: gravelly; slope	Moderate: gravelly; too sandy; slope.
Severe: slope	Severe: gravelly; slope	Severe: slope.
Severe: slope	Severe: gravelly; slope	Severe: slope.
Moderate: gravelly; flooding	Severe: gravelly	Moderate: gravelly; flooding.

volume of soil material to be expected with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to the maintenance of structures built in, on, or with material having this rating.

Corrosivity pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or

TABLE 7.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil series that appear in the first column. The symbol >]

Soil series and map symbols	Depth to—		Depth from surface (representative profile)	USDA texture	Classification		Coarse fraction more than 3 inches
	Seasonal high water table	Bedrock			Unified	AASHTO	
	Feet	*Feet*	*Inches*				*Percent*
Alluvial land: Ab. Properties are too variable to estimate.							
Arnot: AoB ArB ----- No estimates were made for Rock outcrop part of ArB.	>6	1–1½	0–19	Channery loam, very channery silt loam.	GM or SM	A–1, A–2, A–4	0–25
			19	Sandstone bedrock.			
Bath: BaB, BsB -------	>3	>3½	0–31	Channery silt loam, channery loam.	GM, SM, or GC	A–2 or A–4	0–20
			31–60	Channery loam --------	GM, GC, or SM	A–2 or A–4	0–30
Braceville: BvB ------	1½–3	>5	0–24	Gravelly loam ---------	ML, GM, SC, or CL	A–2 or A–4	0–10
			24–34	Gravelly loam ---------	ML, CL, SM, GM, or GC	A–2 or A–4	0–10
			34–60	Stratified sand and gravel.	GM, GC, SM, or SC	A–1 or A–2	0–15
Carlisle: CA --------	0	>5	0–8	Silt loam ----------	ML	A–4	--------
			8–57	Muck (sapric) --------	Pt	----------	--------
			57–109	Silt, silty clay loam ----	ML or CL	A–4 or A–6	--------
Chenango: ChB, ChC, ChD.	>6	>3½	0–12	Gravelly loam ---------	SM, GM	A–2 or A–4	0–15
			12–30	Gravelly loam, very gravelly sandy loam.	SM, GM, or GP	A–1, A–2, or A–4	0–20
			30–80	Stratified sand and gravel.	SM, GM, GP, or SP	A–1 or A–2	5–20
Chippewa: CkA, CkB, ClB.	0–½	>3½	0–12	Silt loam ----------	ML or CL	A–4	0–5
			12–40	Channery silt loam -----	ML or CL	A–4 or A–6	0–25
			40–58	Channery silt loam -----	ML, GM, or SM	A–2 or A–4	5–30
Clymer: CmB, CsB ----	>6	3½–7	0–7	Channery loam --------	GM, GC, ML, or CL	A–2 or A–4	0–5
			7–30	Channery loam, channery clay loam.	GM, GC, SM, ML, or CL	A–2 or A–4	5–20
			30–45	Very channery sandy loam.	GM, SM, SM, or GW–GM	A–1 or A–2	10–30
			45	Sandstone bedrock.			
Cookport: CvB ------	1½–3	>3½	0–6	Loam ----------	SM or ML	A–4	0–10
			6–22	Clay loam ----------	ML, CL, SM, or GM	A–4 or A–6	0–10
			22–48	Clay loam, loam -------	ML, CL, SM, or GM	A–2 or A–4	0–10
			48	Sandstone bedrock.			
DeKalb: DkB, DkC, DsB, DsD, DsF.	>6	1½–3½	0–9	Channery loam, channery sandy loam.	SM, GM, or ML	A–2 or A–4	0–30
			9–25	Channery sandy loam --	ML, SM, or GM	A–2 or A–4	10–40
			25–30	Very channery sandy loam.	SM or GM	A–2 or A–4	10–50
			30	Sandstone bedrock.			

significant to engineering

that may have different properties and limitations. It is therefore necessary to follow carefully instructions for referring to other means more than; the symbol < means less than]

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Optimum moisture	Maximum dry density	Shrink-swell potential	Corrosion potential	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
40–80	30–70	25–65	20–45	0.6–20	0.05–0.10	4.5–5.5	16–24	95–115	Low	Low	High.
60–80	55–70	50–60	30–45	0.6–2.0	0.08–0.12	4.5–6.5	11–20	102–128	Low	Moderate	Moderate.
60–80	45–70	40–60	15–40	0.06–0.2	0.06–0.10	5.1–8.4	8–14	118–129	Low	Low	High.
65–90	55–75	40–60	25–55	0.6–2.0	0.15–0.17	4.5–6.0	12–18	115–120	Low	Moderate	Moderate.
65–90	45–70	40–60	25–55	0.2–0.6	0.05–0.10	4.5–6.0	12–18	115–120	Low	Moderate	Moderate.
40–70	35–55	25–55	15–35	>6.0	0.03–0.06	4.5–6.5	6–11	124–130	Low	Moderate	Moderate.
95–100	95–100	85–100	80–100	2.0–6.0	----------	4.5–6.0	---------	---------	----------	High	High.
				2.0–6.0	---------	4.5–6.0	---------	---------	----------	High	High.
95–100	95–100	85–100	70–100	0.06–2.0	0.10–0.18	5.6–7.3	14–21	105–115	Low	High	High.
55–90	55–70	25–70	15–45	0.6–2.0	0.10–0.14	4.5–5.5	12–18	115–120	Low	Moderate	Moderate.
45–85	30–80	25–70	10–50	0.6–2.0	0.08–0.12	4.5–6.0	10–14	118–130	Low	Low	Moderate.
40–65	30–60	10–50	5–20	>20	0.02–0.06	4.5–6.0	8–12	118–130	Low	Low	Moderate.
75–95	65–100	60–90	60–80	0.2–6.0	0.12–0.16	5.6–7.3	---------	---------	Low	High	Low.
75–95	55–70	50–65	50–60	<0.06	0.08–0.12	5.6–6.5	16–20	100–112	Moderate	High	Low.
50–80	45–80	25–70	15–55	<0.06	0.06–0.10	6.6–7.8	12–18	105–120	Low	High	Low.
75–90	70–85	50–70	30–55	0.6–6.0	0.08–0.12	4.0–5.5	---------	---------	Low	Low	High.
60–85	50–85	45–65	30–55	0.6–6.0	0.04–0.08	4.0–5.5	12–16	115–120	Low	Moderate	High.
40–70	25–60	20–40	10–20	2.0–6.0	0.04–0.08	4.0–5.5	11–17	110–120	Low	Low	Moderate.
80–100	65–100	60–80	40–70	0.6–6.0	0.14–0.18	4.5–5.5	---------	---------	Low	Moderate	High.
65–95	65–95	50–90	40–75	0.6–2.0	0.10–0.12	4.5–5.5	11–16	110–120	Low	Moderate	High.
70–100	65–95	50–85	30–55	0.06–0.2	0.04–0.08	4.5–5.5	9–14	114–129	Low	Moderate	High.
65–85	60–75	45–65	15–55	6.0–20	0.06–0.10	4.5–5.5	---------	---------	Low	Low	High.
65–85	60–80	55–75	20–55	6.0–20	0.06–0.10	4.5–5.5	10–15	115–123	Low	Low	High.
45–85	20–45	20–45	15–40	6.0–20	0.03–0.06	4.5–5.5	9–13	115–125	Low	Low	High.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface (representative profile)	USDA texture	Classification		Coarse fraction more than 3 inches
	Seasonal high water table	Bedrock			Unified	AASHTO	
	Feet	*Feet*	*Inches*				*Percent*
Kanona: KaB, KaC, KcD3.	0–1½	3½–5	0–7	Silt loam	ML	A–4	
			7–25	Silty clay loam, silty clay.	SM, SC, ML, or CL	A–4, A–6, or A–7	
			25–48	Shaly and very shaly silty clay loam.	ML, CL, SM, or GM	A–4 or A–6	
			48	Shale bedrock.			
Lackawanna: LaB, LaC.	>3	>3½	0–30	Channery loam, gravelly loam.	ML, CL, GM, or SM	A–2 or A–4	0–20
			30–44	Gravelly loam	GM or SM	A–2 or A–4	0–20
			44–68	Gravelly loam	GM, SM, or GC	A–2 or A–4	0–20
Lordstown: LoB, LoC, LoD, LsB, LsD.	>6	1½–3½	0–7	Channery loam	GM or SM	A–2 or A–4	0–10
			7–32	Channery loam	GM or SM	A–2 or A–4	0–30
			32–38	Channery loam	GM or SM	A–1 or A–2	10–40
			38	Sandstone bedrock.			
Mardin: MaA, MaB, MaC, MaD, MdB, MdD.	1½–3	>5	0–24	Channery silt loam	ML, CL, GM, SM, or GC	A–4	0–15
			24–75	Very channery silt loam, very channery loam.	ML, CL, GM, SM, or GC	A–2, A–4, A–6	0–15
Morris: MoA, MoB, MoC, MoD, MsB, MsD.	½–1½	>3½	0–20	Gravelly silt loam	ML, SM, or GM	A–4	0–20
			20–56	Gravelly loam	ML, CL, SM, or GM	A–4	0–20
Norwich: No, Ns	0	>3½	0–22	Silt loam, loam	ML or CL	A–4 or A–6	0–10
			22–36	Gravelly silty clay loam.	ML, CL, SM, or SC	A–4 or A–6	0–20
			36–58	Gravelly silty clay loam.	ML, CL, SC, or SM	A–2 or A–4	0–20
*Oquaga: OgB, OgC, OgD, OsB, OsD, OTF, OVF For Lordstown part of OTF, see Lordstown series. Rock outcrop part of OVF not rated.	>6	1½–3½	0–5	Channery loam	SM, ML, or GM	A–2 or A–4	0–5
			5–26	Channery loam, very channery loam.	SM, GM, or ML	A–1, A–2, or A–4	5–30
			26	Sandstone and shale bedrock.			
Orrville: Ow	½–1½	>6	0–48	Silt loam	ML	A–4	
			48–66	Silty clay loam	ML or CL	A–4 or A–6	
Philo: Ph	1½–3	>6	0–30	Silt loam	ML	A–4	
			30–66	Silt loam	ML, SM, or GM	A–4	
Pope: Po, Pp	>3	>6	0–46	Loam, fine sandy loam	ML, SM, or SC	A–4	
			46–66	Sandy loam	GM or SM	A–2 or A–4	0–5
Rexford: RxA, RxB	½–1½	>6	0–17	Silt loam, loam	ML	A–4	
			17–44	Gravelly loam, gravelly sandy loam.	ML, GM, or SM	A–2 or A–4	0–10
			44–60	Stratified sand and gravel.	GM, SM, or ML	A–2 or A–4	
Stony land, wet: Sw. Properties are too variable to estimate.							

significant to engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Optimum moisture	Maximum dry density	Shrink-swell potential	Corrosion potential	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
95–100	70–95	65–90	60–85	0.6–2.0	0.16–0.20	5.1–6.0			Low	High	High.
90–100	70–100	65–100	45–90	0.06–0.2	0.08–0.14	5.1–6.0	14–22	105–122	Moderate	High	High.
60–85	35–70	35–65	30–60	0.06–0.2	0.08–0.14	5.6–6.5	14–21	105–115	Moderate	High	Moderate.
60–80	55–75	45–70	20–60	0.6–2.0	0.10–0.12	4.5–5.5			Low	Moderate	High.
40–80	40–75	35–60	20–50	0.06–0.2	0.04–0.08	4.5–6.0	11–16	115–122	Low	Low	High.
40–70	40–65	35–55	20–40	0.06–0.2	0.04–0.08	4.5–6.0	10–14	120–128	Low	Low	High.
60–75	55–70	30–55	25–45	0.6–2.0	0.06–0.10	4.0–5.5			Low	Low	High.
45–75	40–70	30–55	25–45	0.6–2.0	0.06–0.10	4.5–5.5	10–14	116–124	Low	Low	High.
35–65	30–55	20–50	15–30	0.6–2.0	0.03–0.08	4.5–5.5	9–13	120–130	Low	Low	High.
60–80	55–75	45–75	35–55	0.6–2.0	0.10–0.14	4.5–7.3	10–15	110–125	Low	Moderate	High.
55–90	30–70	35–75	25–55	0.06–0.2	0.06–0.10	4.5–7.8	10–12	123–128	Low	Moderate	High.
60–95	55–90	40–85	35–60	0.6–2.0	0.10–0.14	4.5–6.0			Low	High	Moderate.
60–95	55–90	40–85	35–60	0.06–0.2	0.08–0.12	4.5–6.0	10–14	118–127	Low	High	Moderate.
85–100	80–95	70–90	55–90	0.6–2.0	0.14–0.18	5.1–6.5			Low	High	Moderate.
85–100	60–90	55–90	45–85	<0.06	0.04–0.08	5.1–6.5	12–16	116–123	Low	High	Moderate.
75–85	60–80	55–75	30–65	<0.06	0.08–0.12	5.1–7.3	10–14	116–125	Low	High	Moderate.
60–85	50–75	30–60	25–55	0.6–2.0	0.06–0.10	5.1–6.0			Low	Moderate	High.
35–70	30–65	20–60	15–55	0.6–2.0	0.04–0.08	5.1–6.0	10–16	114–131	Low	Low	High.
95–100	80–100	80–100	75–95	0.6–2.0	0.16–0.20	5.1–7.3	12–18	105–116	Moderate	High	High.
80–100	70–100	60–95	55–95	0.6–2.0	0.06–0.10	5.1–7.3	8–12	115–125	Low	High	Moderate.
75–100	70–100	60–80	55–75	0.6–2.0	0.12–0.16	4.5–6.0	10–14	110–120	Moderate	Moderate	Moderate.
55–80	50–70	50–70	35–55	0.6–2.0	0.05–0.08	4.5–6.0	8–12	115–120	Low	Moderate	Moderate.
80–100	70–100	55–75	40–65	0.6–2.0	0.10–0.14	5.1–6.0	10–14	110–120	Low	Moderate	Moderate.
60–100	55–90	40–50	20–45	0.6–6.0	0.06–0.10	4.5–5.5	8–12	115–120	Low	Low	Moderate.
85–100	80–95	75–90	65–80	0.6–2.0	0.10–0.14	4.5–6.0			Low	High	High.
60–90	55–80	40–70	25–55	0.06–0.2	0.08–0.12	5.1–6.5	10–15	110–120	Low	High	High.
60–85	50–75	40–65	15–55	2.0–20	0.04–0.08	5.1–6.5	10–15	115–125	Low	High	High.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface (representative profile)	USDA texture	Classification		Coarse fraction more than 3 inches
	Seasonal high water table	Bedrock			Unified	AASHTO	
	Feet	*Feet*	*Inches*				*Percent*
Volusia: VoA, VoB, VoC, VoD, VoD3, VoE3, VsB, VsD, VtB.	½–1½	>3½	0–16	Channery silt loam, channery loam.	ML or SM	A–4	0–20
			16–56	Channery loam	GM, GC, ML, CL, or SM	A–4	0–20
VvB, VvC, VvD3.	½–1½	>5	0–16	Channery silt loam, channery loam.	ML or SM	A–4	0–20
			16–56	Channery loam	GM, GC, ML, SM, or CL	A–4	0–20
			56–80	Silt loam, silty clay loam, silty clay.	MH, CL, or MH	A–4, A–6, or A–7	
Wayland: Wa	0	>6	0–30	Silty clay loam	ML or CL	A–4 or A–6	
			30–64	Silty clay loam	ML, CL, SM, or SC	A–4, A–6, or A–7	
Wellsboro: WeA, WeB, WeC, WeD, WsB, WsD.	1½–3½	>3½	0–9	Channery loam	ML, SM, or GM	A–2 or A–4	0–15
			9–20	Channery loam, channery fine sandy loam.	ML, CL, SM, SC, or GM	A–2 or A–4	0–15
			20–60	Gravelly loam, very gravelly loam.	ML, SM, SC, GM, CL, or GC	A–2 or A–4	0–15
Wyoming: WyC, WyD, WyF, Wz.	>6	>5	0–7	Gravelly sandy loam	SM or GM	A–2	0–15
			7–30	Very gravelly sandy loam.	SM, GM, SP, or GP	A–1 or A–2	0–15
			30–80	Stratified sand, gravel, and cobblestone.	SM, SP, GM, GW, or SW	A–1 or A–2	5–30

concrete. Rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity of the soil material. Corrosivity for concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that there is a low probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Soil interpretations

The estimated interpretations in table 8 are based on the engineering properties of soils shown in table 7, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Tioga County. In table 8, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for drainage, sprinkler irrigation, ponds and reservoirs, embankments, and terraces and diversions. For these particular uses, table 8 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil suitability is indicated by the ratings good, fair, and poor. *Good* means soil properties generally are favorable for the rated use, or in other words, the limitations are minor and easily overcome. *Fair* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Poor* means soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation and special designs.

Following are explanations of some of the colums in table 8.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as in preparing a seedbed; natural fertility of the material or plant response when fertilizer is added to the soil; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments affect suitability, and also considered in the ratings is damage that results at the area from which topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 8 provide guidance about where to look for probable

significant to engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Optimum moisture	Maximum dry density	Shrink-swell potential	Corrosion potential	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
75–95	70–85	65–85	45–70	0.6–2.0	0.14–0.18	4.5–5.5			Low	High	Moderate.
65–90	30–80	30–75	25–65	<0.06	0.08–0.12	4.5–6.5	12–16	116–126	Low	High	Moderate.
75–95	70–85	65–85	45–70	0.6–2.0	0.14–0.18	4.5–6.0			Low	High	Moderate.
65–90	55–80	50–75	40–65	<0.06	0.08–0.12	4.5–6.5	12–16	116–126	Low	High	Moderate.
95–100	95–100	90–100	85–100	<0.06	0.08–0.12	6.1–7.8	15–20	108–116	Moderate	High	Moderate.
95–100	95–100	90–100	85–100	0.2–2.0	0.12–0.16	5.1–6.5	15–20	95–100	Moderate	High	Moderate.
95–100	80–100	70–95	35–95	0.06–0.2	0.14–0.18	5.1–6.5	8–12	115–120	Low	High	Moderate.
70–90	50–85	45–85	30–60	0.6–2.0	0.12–0.16	4.5–6.0			Low	Moderate	High.
70–90	50–90	45–85	30–65	0.6–2.0	0.10–0.14	4.5–6.0	10–24	100–124	Low	Moderate	High.
65–85	40–80	35–65	30–55	0.06–0.2	0.06–0.10	4.5–6.0	10–13	122–130	Low	Moderate	High.
70–90	40–60	25–55	15–25	2.0–6.0	0.09–0.12	5.1–6.0	10–14	118–130	Low	Low	Moderate.
45–70	30–60	15–40	10–25	6.0–20	0.08–0.10	5.1–6.0	8–12	118–130	Low	Low	Moderate.
35–65	20–60	15–30	5–15	6.0–20	0.04–0.08	5.1–6.0	10–21	105–130	Moderate	Low	Moderate.

sources. A soil rated as *good* or *fair* source generally has a layer of sand or gravel at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the material, and neither do they indicate quality of the deposit.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and the relative ease of excavating the material at borrow areas.

Highway and road location is for areas that have an all-weather surface which is expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material, and the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments for ponds need soil material that is resistant to seepage and piping and that is of favorable stability, shrink-swell potential, shear strength, and capactibility. Stones or organic material in a soil are among factors that are unfavorable.

Drainage is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Sprinkler irrigation of a soil is affected by such features as slope; susceptibility to stream overflow,

TABLE 8.—*Soil interpretations*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that series that appear

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering use for—	
	Topsoil	Sand and gravel	Road fill	Highway and road location	Pond: Reservoir areas
Alluvial land: Ab. Too variable for interpretations.					
Arnot: AoB, ArB — No interpretations for Rock outcrop part of ArB.	Poor: coarse fragments.	Unsuited	Poor: limited quantities.	Bedrock at a depth of 1 foot to 1½ feet; rock outcrop.	Bedrock at a depth of 1 foot to 1½ feet; moderate to rapid permeability.
Bath: BaB, BsB	Poor: coarse fragments.	Unsuited	Fair: frost action.	Seepage above fragipan.	Features generally favorable.
Braceville: BvB	Poor: coarse fragments.	Poor: too silty.	Fair: thin layer; small stones.	Seasonal high water table at a depth of 1½ to 3 feet.	Seasonal high water table at a depth of 1½ to 3 feet; permeable substratum.
Carlisle: CA	Poor: good for organic material.	Unsuited	Poor: organic material.	Organic material; water table at surface.	Water table at surface.
Chenango: ChB, ChC, ChD	Poor: coarse fragments.	Good to fair	Good	Features generally favorable.	Moderate to rapid permeability.
Chippewa: CkA, CkB, ClB	Poor: high water table.	Unsuited	Poor: high water table.	High water table at a depth of 0 to ½ foot; stony in some areas.	Water table at a depth of 0 to ½ foot.
Clymer: CmB, CsB	Poor: coarse fragments.	Unsuited	Fair: fines	Some areas stony.	Moderate to moderately rapid permeability.

for engineering uses

may have different properties and limitations. It is therefore necessary to follow carefully the instructions for referring to other in the first column]

Soil features affecting engineering use for—Continued						
Pond—Continued Embankments	Drainage	Sprinkler irrigation	Terraces and diversions	Grassed waterways	Winter grading	Pipeline construction and maintenance
Moderate permeability; medium susceptibility to piping.	Bedrock at a depth of 1 foot to 1½ feet.	Shallow root zone; very low available water capacity.	Bedrock at a depth of 1 foot to 1½ feet; rock outcrop.	Bedrock at a depth of 1 foot to 1½ feet; rock outcrop.	Features generally favorable.	Bedrock at a depth of 1 foot to 1½ feet; rock outcrop.
Medium shear strength; medium susceptibility to piping.	Fragipan at a depth of 26 to 36 inches; slow permeability.	Slow permeability; stony in some areas.	Stony in some areas.	Stony in some areas.	Features generally favorable.	Stony in some areas.
Medium to low shear strength; medium compressibility; medium to high susceptibility to piping.	Fragipan at a depth of 20 to 30 inches; seasonal high water table at a depth of 1½ to 3 feet; moderately slow permeability.	Moderately slow permeability; seasonal high water table at a depth of 1½ to 3 feet.	Seasonal high water table at a depth of 1½ to 3 feet.	Seasonal high water table at a depth of 1½ to 3 feet.	Seasonal high water table at a depth of 1½ to 3 feet; forms large frozen clods.	Seasonal high water table at a depth of 1½ to 3 feet.
Organic material.	Water table at surface; limited outlets.	Water table at surface.	Water table at surface; organic material.	Water table at surface; organic material.	Water table at surface; organic material.	Water table at surface; organic material.
Moderate to rapid permeability; medium to high susceptibility to piping.	Well drained to somewhat excessively drained.	Low available water capacity.	Irregular slopes.	Irregular slopes.	Features generally favorable.	Unstable trench walls.
Medium to low shear strength; medium compressibility; medium to high susceptibility to piping.	Fragipan at a depth of about 12 inches; high water table at a depth of 0 to ½ foot; very slow permeability.	Shallow root zone; very slow permeability; high water table at a depth of 0 to ½ foot; stony in some areas.	High water table at a depth of 0 to ½ foot; stony in some areas.	High water table at a depth of 0 to ½ foot; stony in some areas.	High water table at a depth of 0 to ½ foot; stony in some areas.	High water table at a depth of 0 to ½ foot; stony in some areas.
Medium to low shear strength; moderate permeability; medium susceptibility to piping.	Well drained ---	Some areas stony.	Some areas stony.	Some areas stony.	Features generally favorable.	Some areas stony.

TABLE 8.—*Soil interpretations*

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering use for—	
	Topsoil	Sand and gravel	Road fill	Highway and road location	Pond: Reservoir areas
Cookport: CvB	Fair: thin layer.	Unsuited	Fair: frost action; low strength.	Seasonal high water table at a depth of 1½ to 3 feet; stony.	Seasonal high water table at a depth of 1½ to 3 feet.
Dekalb: DkB, DkC, DsB, DsD, DsF.	Poor: coarse fragments.	Poor: too silty.	Poor: limited quantities.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.	Bedrock at a depth of 1½ to 3½ feet; rapid permeability.
Kanona: KaB, KaC, KcD3	Poor: high water table.	Unsuited	Poor: high water table.	High water table at a depth of 0 to 1½ feet.	High water table at a depth of 0 to 1½ feet.
Lackawanna: LaB, LaC	Poor: coarse fragments.	Unsuited	Fair: frost action.	Seepage above fragipan.	Features generally favorable.
Lordstown: LoB, LoC, LoD, LsB, LsD.	Poor: coarse fragments.	Unsuited	Poor: limited quantities.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.	Bedrock at a depth of 1½ to 3½ feet; moderate permeability.
Mardin: MaA, MaB, MaC, MaD, MdB, MdD.	Poor: coarse fragments.	Unsuited	Fair: frost action.	Seasonal high water table at a depth of 1½ to 3 feet; stony in some areas.	Seasonal high water table at a depth of 1½ to 3 feet.
Morris: MoA, MoB, MoC, MoD MsB, MsD.	Poor: coarse fragments.	Unsuited	Fair: frost action.	Seasonal high water table at a depth of ½ foot to 1½ feet; stony in some areas.	Seasonal high water table at a depth of ½ foot to 1½ feet.

for engineering uses—Continued

Soil features affecting engineering use for—Continued						
Pond—Continued Embankments	Drainage	Sprinkler irrigation	Terraces and diversions	Grassed waterways	Winter grading	Pipeline construction and maintenance
Medium to low shear strength; medium compressibility; medium to high susceptibility to piping.	Fragipan at a depth of about 22 inches; seasonal high water table at a depth of 1½ to 3 feet; slow permeability.	Slow permeability; seasonal high water table at a depth of 1½ to 3 feet; stony.	Seasonal high water table at a depth of 1½ to 3 feet; stony.	Seasonal high water table at a depth of 1½ to 3 feet; stony.	Seasonal high water table at a depth of 1½ to 3 feet; stony; forms large frozen clods.	Seasonal high water table at a depth of 1½ to 3 feet; stony.
Medium shear strength; moderate permeability; medium susceptibility to piping.	Well drained	Stony; low available water capacity.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.	Features generally favorable.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.
Medium to low shear strength; medium compressibility; medium to high susceptibility to piping.	High water table at a depth of 0 to 1½ feet; slow permeability.	Slow permeability; high water table at a depth of 0 to 1½ feet.	High water table at a depth of 0 to 1½ feet.	High water table at a depth of 0 to 1½ feet.	High water table at a depth of 0 to 1½ feet; forms large frozen clods.	High water table at a depth of 0 to 1½ feet.
Medium to low shear strength; moderate to low permeability; medium to high susceptibility to piping.	Fragipan at a depth of 24 to 36 inches; slow permeability.	Slow permeability.	Features generally favorable.	Features generally favorable.	Features generally favorable.	Features generally favorable.
Medium to high shear strength; medium to low susceptibility to piping.	Well drained	Moderate to low available water capacity; stony in some areas.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.	Features generally favorable.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.
Medium to low shear strength; medium compressibility; medium to high susceptibility to piping.	Fragipan at a depth of 14 to 26 inches; seasonal high water table at a depth of 1½ to 3 feet; slow permeability.	Slow permeability; seasonal high water table at a depth of 1½ to 3 feet; stony in some areas.	Seasonal high water table at a depth of 1½ to 3 feet; stony in some areas.	Seasonal high water table at a depth of 1½ to 3 feet; stony in some areas.	Seasonal high water table at a depth of 1½ to 3 feet; forms large frozen clods.	Seasonal high water table at a depth of 1½ to 3 feet; stony in some areas.
Medium to low shear strength; medium compressibility; medium to high susceptibility to piping.	Fragipan at a depth of 12 to 22 inches; seasonal high water table at a depth of ½ foot to 1½ feet; slow permeability.	Shallow root zone; slow permeability; seasonal high water table at a depth of ½ foot to 1½ feet.	Seasonal high water table at a depth of ½ foot to 1½ feet; stony in some areas.	Seasonal high water table at a depth of ½ foot to 1½ feet; stony in some areas.	Seasonal high water table at a depth of ½ foot to 1½ feet; forms large frozen clods.	Seasonal high water table at a depth of ½ foot to 1½ feet; stony in some areas.

TABLE 8.—*Soil interpretations*

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering use for—	
	Topsoil	Sand and gravel	Road fill	Highway and road location	Pond: Reservoir areas
Norwich: No, Ns	Poor: high water table.	Unsuited	Poor: high water table.	High water table at surface; stony in some areas.	High water table at surface.
*Oquaga: OgB, OgC, OgD, OsB, OsD, OTF, OVF. For Lordstown part of OTF, see Lordstown series. No interpretations for Rock outcrop part of OVF.	Poor: coarse fragments.	Unsuited	Poor: limited quantities.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.	Bedrock at a depth of 1½ to 3½ feet; moderate permeability.
Orrville: Ow	Fair: firm consistence.	Unsuited	Fair: frost action.	Seasonal high water table at a depth of ½ foot to 1½ feet; hazard of flooding.	Seasonal high water table at a depth of ½ foot to 1½ feet; hazard of flooding; moderate permeability.
Philo: Ph	Good	Unsuited	Fair: low strength.	Seasonal high water table at a depth of 1½ to 3 feet; hazard of flooding.	Seasonal high water table at a depth of 1½ to 3 feet; moderate permeability.
Pope: Po Pp	Good	Unsuited	Fair: low strength.	Hazard of flooding.	Hazard of flooding; moderate permeability.
Rexford: RxA, RxB	Fair: coarse fragments.	Poor: too silty.	Fair: seasonal high water table at a depth of ½ foot to 1½ feet.	Seasonal high water table at a depth of ½ foot to 1½ feet.	Seasonal high water table at a depth of ½ foot to 1½ feet; permeable substratum.
Stony land, wet: Sw. Material is too variable for interpretations.					
Volusia: VoA, VoB, VoC, VoD, VoD3, VoE3, VsB, VsD, VtB	Poor: coarse fragments.	Unsuited	Fair: seasonal high water table at a depth of ½ foot to 1½ feet.	Seasonal high water table at a depth of ½ foot to 1½ feet; stony in some areas.	Seasonal high water table at a depth of ½ foot to 1½ feet.

for engineering uses—Continued

Soil features affecting engineering use for—Continued						
Pond—Continued Embankments	Drainage	Sprinkler irrigation	Terraces and diversions	Grassed waterways	Winter grading	Pipeline construction and maintenance
Medium to low shear strength; medium to high susceptibility to piping.	Fragipan at a depth of 10 to 24 inches; high water table at surface; very slow permeability.	Shallow root zone; very slow permeability; high water table at surface.	High water table at surface; stony in some areas.	High water table at surface; stony in some areas.	High water table at surface; stony in some areas.	High water able at surface; stony in some areas.
Medium to high shear strength; moderate permeability; medium to low susceptibility to piping.	Well drained	Very low available water capacity; stony in some areas.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.	Features generally favorable.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.
Medium to low shear strength; medium compressibility; high susceptibility to piping.	Seasonal high water table at a depth of ½ foot to 1½ feet; hazard of flooding.	Seasonal high water table at a depth of ½ foot to 1½ feet; hazard of flooding.	Seasonal high water table at a depth of ½ foot to 1½ feet; hazard of flooding.	Seasonal high water table at a depth of ½ foot to 1½ feet; hazard of flooding.	Seasonal high water table at a depth of ½ foot to 1½ feet; forms large frozen clods.	Seasonal high water table at a depth of ½ foot to 1½ feet; hazard of flooding.
Medium to low shear strength; medium compressibility; high susceptibility to piping.	Seasonal high water table at a depth of 1½ to 3 feet; hazard of flooding.	Seasonal high water table at a depth of 1½ to 3 feet; hazard of flooding.	Seasonal high water table at a depth of 1½ to 3 feet; hazard of flooding.	Seasonal high water table at a depth of 1½ to 3 feet; hazard of flooding.	Seasonal high water table at a depth of 1½ to 3 feet; forms large frozen clods.	Seasonal high water table at a depth of 1½ to 3 feet; hazard of flooding.
Medium to low shear strength; moderate to low permeability; medium to high susceptibility to piping.	Hazard of flooding; well drained.	Hazard of flooding.	Hazard of flooding.	Hazard of flooding.	Features generally favorable.	Hazard of flooding.
Medium to low shear strength; medium compressibility; medium to high susceptibility to piping.	Fragipan at a depth of 15 to 24 inches; seasonal high water table at a depth of ½ foot to 1½ feet.	Slow permeability; seasonal high water table at a depth of ½ foot to 1½ feet.	Seasonal high water table at a depth of ½ foot to 1½ feet.	Seasonal high water table at a depth of ½ foot to 1½ feet.	Seasonal high water table at a depth of ½ foot to 1½ feet; forms large frozen clods.	Seasonal high water table at a depth of ½ foot to 1½ feet.
Medium to low shear strength; medium compressibility; medium to high susceptibility to piping.	Fragipan at a depth of 12 to 20 inches; seasonal high water table at a depth of ½ foot to 1½ feet; very slow permeability.	Very slow permeability; seasonal high water table at a depth of ½ foot to 1½ feet; shallow root zone.	Seasonal high water table at a depth of ½ foot to 1½ feet; stony in some places.	Seasonal high water table at a depth of ½ foot to 1½ feet; stony in some areas.	Seasonal high water table at a depth of ½ foot to 1½ feet; forms large frozen clods.	Seasonal high water table at a depth of ½ to 1½ feet; stony in some areas.

TABLE 8.—*Soil interpretations*

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering use for—	
	Topsoil	Sand and gravel	Road fill	Highway and road location	Pond: Reservoir areas
Volusia: VvB, VvC VvD3	Poor: coarse fragments.	Unsuited	Poor: unstable when disturbed.	Seasonal high water table at a depth of ½ foot to 1½ feet; unstable material at a depth of 3½ feet; cut slopes unstable.	Seasonal high water table at a depth of ½ foot to 1½ feet; cut slopes unstable.
Wayland: We	Poor: high water table.	Unsuited	Poor: too clayey.	High water table at surface; hazard of flooding.	High water table at surface; hazard of flooding.
Wellsboro: WeA, WeB, WeC, WeD, WsB, WsD.	Poor: coarse fragments.	Unsuited	Fair: frost action.	Seasonal high water table at a depth of 1½ to 3 feet; stony in some areas.	Seasonal high water table at a depth of 1½ to 3 feet.
Wyoming: WyC, WyD, WyF	Poor: coarse fragments.	Good to fair	Good	Features generally favorable.	Rapid permeability.
Wz	Poor: coarse fragments.	Fair: too silty.	Good	Hazard of flooding.	Rapid permeability; hazard of flooding.

water erosion, or soil blowing; texture; content of stones; accumulation of salts and alkali; depth of root zone; rate of water intake at the surface; permeability below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or to other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Grassed waterways are affected by such soil properties as texture, depth, and erodibility of the soil material; presence of stones or rock outcrops; and the steepness of slopes. Other factors affecting waterways are seepage, drainage, available water capacity, susceptibility to siltation, and the ease of establishing and maintaining vegetation.

Winter grading is affected chiefly by features that are relevant to moving, mixing, and compacting soil in road building when temperatures are below freezing.

Pipeline construction and maintenance and other shallow excavations for sewer lines, phone and power

for engineering uses—Continued

Soil features affecting engineering use for—Continued						
Pond—Continued						
Embankments	Drainage	Sprinkler irrigation	Terraces and diversions	Grassed waterways	Winter grading	Pipeline construction and maintenance
Medium to low shear strength; medium compressibility; medium to high susceptibility to piping.	Fragipan at a depth of 12 to 20 inches; seasonal high water table at a depth of ½ foot to 1½ feet; very slow permeability; ditch walls unstable.	Very slow permeability; seasonal high water table at a depth of ½ foot to 1½ feet; shallow root zone; stony in some areas.	Seasonal high water table at a depth of ½ foot to 1½ feet; cut slopes unstable.	Seasonal high water table at a depth of ½ foot to 1½ feet; cut slopes unstable.	Seasonal high water table at a depth of ½ foot to 1½ feet; forms large frozen clods.	Seasonal high water table at a depth of ½ foot to 1½ feet; unstable walls; subject to downslope movement.
Medium to low shear strength; medium compressibility; medium to high susceptibility to piping.	High water table at surface; hazard of flooding; slow permeability.	Slow permeability; high water table at surface; slow permeability; hazard of flooding.	High water table at surface; hazard of flooding.	High water table at surface; hazard of flooding.	High water table at surface; forms large frozen clods.	High water table at surface; hazard of flooding.
Medium to low shear strength; medium compressibility; medium to high susceptibility to piping.	Fragipan at a depth of 16 to 26 inches; seasonal high water table at a depth of 1½ to 3 feet; slow permeability.	Slow permeability; seasonal high water table at a depth of 1½ to 3 feet; stony in some areas.	Seasonal high water table at a depth of 1½ to 3 feet; stony in some areas.	Seasonal high water table at a depth of 1½ to 3 feet; stony in some areas.	Seasonal high water table at a depth of 1½ to 3 feet; forms large frozen clods.	Seasonal high water table at a depth of 1½ to 3 feet; stony in some areas.
High permeability; medium to high susceptibility to piping.	Somewhat excessively drained.	Low available water capacity.	Irregular slopes.	Irregular slopes.	Features generally favorable.	Unstable trench walls.
High permeability; medium to high susceptibility to piping.	Somewhat excessively drained; hazard of flooding.	Low available water capacity; hazard of flooding.	Hazard of flooding.	Hazard of flooding.	Features generally favorable.	Unstable trench walls; hazard of flooding.

transmission lines, basements, open ditches, and cemeteries generally require digging or trenching to a depth of less than 6 feet. Desirable soil properties for these excavations are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or from a high water table.

Soil test data

Table 9 contains engineering test data for some of the major soil series in Tioga County. The tests were made to help evaluate the soils for engineering purposes. The engineering classifications are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Compaction (or moisture-density) data are important in earthwork. If soil material is compacted at successively higher moisture contents, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil ma-

TABLE 9.—*Soil*

[Tests performed by the Pennsylvania Department of Transportation in accordance with standard

Soil name and location (All profiles are modal)	Parent material	Report number	Depth	Moisture-density data [1]		Mechanical analyses [2]				
				Maximum dry density	Optimum moisture	Percentage passing sieve—				
						3 in	2 in	1½ in	1 in	¾ in
			Inches	*Lb/cu ft*	*Percent*					
Arnot channery loam: 3.5 miles southeast of Sabinsville.	Glacial till.	BK38506	2–15	108	18	----------	----------	100	92	85
Chenango gravelly loam: 650 feet north of the Catholic Church in Arnot.	Water-sorted sand and gravel.	BK36395	12–21	118	14	----------	100	92	86	84
		BK36396	30–80	127	10	----------	100	84	78	74
Kanona silt loam: 2.6 miles south of Wellsboro.	Glacial till.	BK15435	7–16	105	22	----------	100	100	100	100
Lordstown channery loam: 3.0 miles northwest of Asaph.	Glacial till.	BK34573	13–32	123	11	----------	100	95	88	79
		BK34574	32–38	126	10	100	89	89	82	78
Morris gravelly silt loam: 3.0 miles southeast of Mainesburg.	Glacial till.	BK33254	20–36	122	11	----------	----------	100	89	85
		BK33255	48–56	121	11	----------	----------	100	92	87
Oquaga channery loam: 2.0 miles of south of Mainesburg.	Glacial till.	BK19706	10–18	131	11	----------	----------	100	96	94
		BK19707	18–36	127	11	----------	100	93	83	76
Orrville silt loam: 0.5 mile south of Middleburg Center.	Alluvium.	BK36387	17–29	111	16	----------	----------	----------	----------	----------
		BK36388	29–40	116	15	----------	----------	----------	----------	----------
Wellsboro channery loam: 2.0 miles west of Liberty.	Glacial till.	BK36385	9–16	100	23	----------	----------	100	95	94
		BK36386	34–48	122	12	100	92	84	81	79
Wyoming gravelly sandy loam: 3.1 miles west of Lambs Creek.	Water-sorted sand and gravel.	BK34207	7–30	126	11	100	84	84	79	75
		BK34208	30–80	128	10	----------	----------	100	90	81

[1] Based on AASHTO designation T99–57, method A.

[2] Mechanical analyses are according to AASHTO designation T88–57 (*2*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine

terial. As the moisture content of a clayey soil is increased from a dry state, the material changes from semisolid to plastic. If the moisture content is further increased, the material changes from plastic to liquid. The plastic limit is the moisture content at which the soil material changes from semisolid to plastic; and the liquid limit, from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Formation, Morphology, and Classification of the Soils

This section of the soil survey discusses the formation and classification of the soils in Tioga County. The first part tells how the soils have formed. The second part describes processes of soil formation and discusses the soil profile. The third part classifies the soils according to the current system of classification.

Soil formation begins with the physical weathering

test data

procedures of the American Association of State Highway and Transportation Officials (AASHTO)]

Mechanical analyses [3]—Continued									Liquid limit	Plasticity index	Classification	
Percentage passing sieve—Continued					Percentage smaller than—						AASHTO [3]	Unified [4]
⅜ in	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm				
									Percent			
74	68	59	51	35	33	26	15	9	34	4	A–2–4(0)	SM
78	73	68	59	46	43	33	19	13	25	2	A–4(2)	GM
66	61	56	46	19	15	10	6	5	--------	[5] NP	A–1–b(0)	SM
99	99	99	98	91	89	78	59	45	44	18	A–7–6(12)	CL
66	57	50	43	30	28	22	12	8	21	NP	A–2–4(0)	GM
67	56	47	39	25	23	20	11	7	20	1	A–1–b(0)	GM
82	80	76	70	57	52	37	21	14	21	3	A–4(4)	ML
77	70	64	58	46	4	30	13	8	21	2	A–4(2)	GM
79	64	51	33	28	27	22	11	7	30	5	A–2–4(0)	GM
63	51	40	30	25	24	17	8	5	25	2	A–1–b(0)	GM
--------	--------	100	99	92	86	60	31	21	25	1	A–4(8)	ML
--------	--------	100	98	81	71	39	22	16	22	NP	A–4(8)	ML
91	88	87	84	63	60	56	23	15	37	5	A–4(5)	ML
72	69	66	61	45	43	33	20	15	23	4	A–4(2)	GM–GC
59	45	32	17	12	11	9	5	4	27	2	A–1–a(0)	GM
54	36	25	17	9	8	5	4	2	19	NP	A–1–a(0)	GM

material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

[3] Based on AASHTO designation M145–66T.

[4] Based on the Unified soil classification system (*3*).

[5] NP means nonplastic.

of rocks. Large pieces of rock are broken into smaller pieces by frost wedging, expansion, and contraction, hydration, and many other natural forces. Eventually, the rock and its fragments are reduced to sand and silt. Plants take root and grow in this layer of unconsolidated soil material. A mat of organic material is formed on the surface as the plants mature and die. This can be observed on Lordstown, Dekalb, and other soils in forests. Organic matter from the mat is added to the mineral soil.

During the weathering process, minerals decompose and some are leached out in solution. As a result of this leaching some soils are deficient in minerals such as phosphorus and other minor elements.

The minerals in the soil are taken into the plants by the roots. Eventually the plants mature, die, fall to the ground, decay, and return part of the nutrients to the soil. The cycle begins again and is repeated. As the cycle continues the soil matures and fine particles, such as clay, form and tend to accumulate in the subsoil. Additions of fertilizer are needed to replace the nutrients as plants reduce the available supply.

Factors of Soil Formation

Soils are complex mixtures of weathered rock, minerals, organic matter, water, and air. They form through the interaction of five major factors: parent material, plant and animal life, climate, relief, and time. The importance of each of these factors varies from place to place. Local variations in soils are due to differences in the kinds of parent materials, topography, and drainage. In places, one factor may dominate the formation of a soil and determine most of its properties.

Parent material

Parent material is the unconsolidated mass in which soils form. It determines the mineralogical and chemical composition of the soil and, to a large extent, the rate at which soil-forming processes take place.

About 97 percent of the soils in Tioga County formed in glacial till, glacial outwash, recent stream alluvium, and organic material. About 3 percent of the soils in the southwestern part of the county are classified as residual soils. These soils were not glaciated and formed in place from material weathered from the underlying rock. Most of the soil material was deposited as the glaciers retreated about 10,000 to 15,000 years ago. Alluvial and organic material are of recent origin and are still being deposited at the present time. The soils that formed in glacial till are the most extensive and have a wide range of characteristics. Volusia, Morris, Mardin, and Wellsboro soils are examples. The soils that formed in glacial outwash deposits are generally loamy and are underlain by stratified sand and gravel. Examples of these are Wyoming, Chenango, and Braceville soils. Soils in the stream valleys are subject to stream overflow and formed in waterlaid material called recent alluvium. Examples of these are Pope, Philo, and Orrville soils. Carlisle soils formed in organic material.

Plant and animal life

Plants, micro-organisms, earthworms, and other forms of life are active in the formation of soils. They bring about changes that depend mainly on the life processes peculiar to each.

The vegetation generally determines the amount of organic matter in the soil and the color of the surface layer. Earthworms, cicada, and other burrowing insects and animals help keep the soil open and porous. Bacteria and fungi decompose the vegetation. This process of decomposition releases plant nutrients for new plant and animal growth. In Tioga County the soils formed under a forest cover of white pine, hemlock, and some hardwoods, which has greatly influenced soil formation. Man also has influenced soil formation by clearing the forests and plowing the soils. He has added fertilizers and has moved soil material from place to place.

Climate

The climate of Tioga County is characteristic of a humid continental type that is marked by extreme seasonal temperature changes. According to recorded data of the National Weather Service at Lawrenceville, the average precipitation is about 35 inches and the mean annual air temperature is about 48° F. Tioga County has the lowest rainfall in the state (35 inches). The rainfall is rather uniform from May through September, averaging about 18 to 19 inches. The cool temperatures increased the accumulation of organic matter in the surface layer. For more detailed information on climate see the section "Environmental Factors Affecting Soil Use."

Relief

Tioga County is in the glaciated part of the Allegheny Plateau. This region is a dissected plateau within the Susquehanna River drainage system. In places, the plateau is dissected to a depth of several hundred feet. The Pine Creek Valley walls rise as much as 700 to 1,000 feet from the dissected plateau in a distance of less than 1 mile.

The elevation in Tioga County ranges from 996 feet at Lawrenceville to 2,543 feet on Cedar Mountain in the southwestern part of the county. Within the plateau, the difference in elevation between the top of the plateau and the lower elevations is as much as 800 feet. The average elevation throughout most of the county is between 1,000 and 2,000 feet. The upland slopes are gently sloping throughout the broad summit areas, and side slopes are sloping to steep. About 7 percent of the county consists of outwash terraces and flood plains. The general features of the uplands, except in the southwestern corner of the county, are smoothed by glaciation, and the relief is one of smooth curves rather than sharp abrupt features.

The shape of the land surface, and the depth to the water table have had great influence on the formation of soils in the county. Lackawanna soils, for example, formed where runoff is moderate to rapid. They are generally well drained; have a bright-colored, unmottled subsoil; and in most places are leached to a greater depth than wetter soils in the same general area. Wellsboro soils formed in the more gently sloping areas where runoff is slower. These soils generally show some evidence of wetness, such as a mottled subsoil, for short periods of time. In level areas or in slight depressions where the water table is at or near the surface for long periods, soils, for example Norwich soils, show strong evidence of wetness. They have a dark-colored, thick, organic surface layer and a strongly mottled or grayish subsoil. Some soils, however, are wet because of a high water table or because they have a low-lying position. Also, the permeability of the soil material, as well as the length, steepness, and shape of the slopes, influences the kind of soil that forms. Local differences in soils are largely the result of differences in parent material and topography.

Time

The formation of soils requires time, generally a long time, for changes to take place in the parent material. The soils of Tioga County formed in the period since glaciation. Evidence of this limited time can be seen in the soils.

Soils that formed in low bottoms and are subject to varying degrees of overflow can receive new sediment with each flooding. These soils have weak structure and weak color changes from horizon to horizon. Pope soils are examples. Soils that have well developed horizons, such as Volusia soils, formed over a longer period than Pope soils.

Processes of Soil Formation

The results of the many soil-forming factors can be seen in the different layers, or soil horizons, in a profile. The profile extends from the surface downward to material that is little altered by the soil-forming processes.

Most soils have three major horizons referred to as the A, B, and C (*8*) horizons. These major horizons can be further subdivided by the use of numbers and letters to indicate changes within one horizon. An example would be the Bx1 horizon, which is a B horizon that contains a fragipan or a very firm and brittle layer that is impervious to water.

The A horizon is the surface layer. An A1 horizon is that part of the surface layer that contains the largest amount of organic matter. The A horizon is also the layer of maximum leaching or eluviation of clay and iron. If considerable leaching has taken place and organic matter has not darkened the material, the horizon is called A2. In the Cookport soils, the A2 horizon is brownish as a result of the oxidation of iron. An Ap horizon is man made. The surface layer has been plowed, and the original A horizons have been mixed.

The B horizon underlies the A horizon and is commonly called the subsoil. It is the horizon of maximum accumulation, or illuviation, of clay, iron, aluminum, or other compounds leached from the surface layers. In some soils, the B horizon is formed by alteration in place rather than by illuviation. The alterations may be caused by oxidation and reduction of iron or by weathering or clay minerals. The B horizon commonly has blocky or prismatic structure, and it generally is firmer and lighter colored than the A1 horizon, but darker colored than the C horizon.

The C horizon is below the A horizon and B horizon. It consists of material that is little altered by the soil-forming process, but can be modified by weathering.

In Tioga County several processes are involved in the formation of soil horizons. Among these are the accumulation of organic material, the leaching of soluble salts, the reduction and transfer of iron, the formation of soil structure, and the formation and translocation of clay minerals. These processes take place continually and generally at the same time throughout the profile. Such processes have been going on for thousands of years.

The accumulation and incorporation of organic matter take place with the decomposition of plant residue. These additions darken the surface layer and help to form the A1 horizon. Organic matter, once lost, normally takes a long time to be replaced.

In order for soils to have a distinct subsoil horizon, it is believed that some of the lime and other soluble salts are leached before the translocation of clay minerals. Among the factors that affect this leaching are the kinds of salts originally present, the depth to which the soil solution percolates, and the texture of the soil profile.

Well drained and moderately well drained soils in Tioga County have a yellowish brown or reddish brown subsoil. These colors are caused mainly by a thin coating of iron oxides on sand and silt grains, although in some soils, such as Oquaga soils, the colors are inherited from the reddish glacial material in which they formed. Weak to moderate development of subangular blocky structure has taken place, but the subsoil contains little or no more clay than the overlying surface layer.

In most of the moderately well drained and somewhat poorly drained soils of the county, a fragipan has formed in the subsoil. The fragipan is very firm and brittle when moist, and it is very hard when dry. Soil particles are tightly packed so that bulk density is high and pore space is low. Genesis of these horizons is not fully understood, but studies show that swelling and shrinking take place in alternating wet and dry periods. This may account for the packing of soil particles and also for a gross polygonal pattern of cracks in the fragipan. Clay, silica, and oxides of aluminum are the most likely cementing agents causing brittleness and hardness.

Gleying, or the reduction and transfer of iron, is associated mainly with the wetter, more poorly drained soils. Moderately well drained to somewhat poorly drained soils contain yellowish brown and reddish brown mottles, which indicate the segregation of iron. In poorly drained to very poorly drained soils, such as Chippewa and Wayland soils, the subsoil and underlying material are grayish, which indicates reduction and transfer of iron by removal in solution.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available (*10*).

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable (*8*). The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 10, the soil series of Tioga County are placed in three categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and

TABLE 10.—*Classification of the soils*

Series	Family	Subgroup	Order
Arnot	Loamy-skeletal, mixed, mesic	Lithic Dystrochrepts	Inceptisols.
Bath	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols.
Braceville	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols.
Carlisle[1]	Euic, mesic	Typic Medisaprists	Histosols.
Chenango	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Chippewa	Fine-loamy, mixed mesic	Typic Fragiaquepts	Inceptisols.
Clymer	Fine-loamy, mixed mesic	Typic Hapludults	Ultisols.
Cookport	Fine-loamy, mixed mesic	Aquic Fragiudults	Ultisols.
Dekalb	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Kanona	Fine, illitic, nonacid, mesic	Aeric Haplaquepts	Inceptisols.
Lackawanna	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols.
Lordstown[2]	Coarse-loamy, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Mardin	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols.
Morris	Coarse-loamy, mixed, mesic	Aeric Fragiaquepts	Inceptisols.
Norwich	Fine-loamy, mixed, mesic	Typic Fragiaquepts	Inceptisols.
Oquaga	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Orrville	Fine-loamy, mixed, nonacid, mesic	Aeric Fluvaquents	Entisols.
Philo	Coarse-loamy, mixed, mesic	Fluvaquentic Dystrochrepts	Inceptisols.
Pope	Coarse-loamy, mixed, mesic	Fluventic Dystrochrepts	Inceptisols.
Rexford	Coarse-loamy, mixed, mesic	Aeric Fragiaquepts	Inceptisols.
Volusia	Fine-loamy, mixed, mesic	Aeric Fragiaquepts	Inceptisols.
Wayland	Fine-silty, mixed, nonacid, mesic	Mollic Fluvaquents	Entisols.
Wellsboro	Coarse-loamy, mixed, mesic	Typic Fragiochrepts	Inceptisols.
Wyoming	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.

[1] Carlisle soils in Tioga County have a mineral surface layer as much as 15 inches thick, and they have as much as 10 inches of fibric material in the surface and subsurface layers.

[2] Lordstown soils in Tioga County are 35 to 45 percent coarse fragments in the control section.

Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Ent-i-sol).

SUBORDER. Each order is subdivided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquent* (*Aqu,* meaning water or wet, and *ent,* from Entisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark red and dark brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplaquents (*Hapl,* meaning simple horizons, *aqu* for wetness or water, and *ent,* from Entisols).

SUBGROUP. Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Haplaquents (a typical Haplaquent).

FAMILY. Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae. An example is the fine-loamy, mixed, mesic family of Aeric Fragiaquepts.

Laboratory Soil Studies [6]

Six Dystrochrepts, four Haplaquepts, and two Fragiaquepts were sampled and studied in Tioga County. These soils are representative of the glaciated part of northeastern Pennsylvania (*4*). The Haplaquepts sampled are typical of the soils in glaciated upland depressions and nearly level to gently sloping soils that

[6] By R. L. CUNNINGHAM, R. P. MATELSKI, G. W. PETERSEN, and E. J. CIOLKOSZ, Department of Agronomy, The Pennsylvania State University.

are wetter than the surrounding landscape. They are not extensive. The Fragiaquepts are extensive, are nearly level to moderately steep, and are on the glaciated uplands. Some of these soils have more bases within and below the fragipan than others and were formerly separated in mapping. The Dystrochrepts sampled are extensive and occupy the gently sloping to very steep and, generally, the stoniest uplands. The soils in this group, as reflected by their physical and chemical properties, are best suited to forest, wildlife, and recreation.

The samples were grouped for purposes of discussion as follows: (1) pedons 5904 and 5905, Kanona soils, and 5906 and 5907, soils included with Chippewa soil in mapping, are classified as Haplaquepts; (2) pedons 5908 and 5909, soils included in mapping with Volusia soils are Fragiaquepts; and (3) pedons 5910 and 5911, Oquaga soils, 5912 and 5913, Arnot soils, and 5914 and 5916, Lordstown soils, are Dystrochrepts. The soils included in mapping with Chippewa and Volusia soils are sufficiently similar to those series to be useful in understanding and predicting their behavior.

Clay distribution. —Curves illustrating the average clay distribution in a representative pedon of each of the three classification groups are presented in figure 10. The curve for Dystrochrepts shows that these soils decrease in clay content from a maximum of somewhat less than 12 percent as depth increases. The curve for Fragiaquepts indicates that the clay content is generally a maximum of 22 percent in the surface horizon, reaches a mimimum of 13 percent in the A2 horizon, and is about 18 percent in the rest of the profile. The Haplaquepts curve shows that the clay content is uniformly about 23 percent to a depth of 60 centimeters. Some Haplaquepts show a greater percentage of clay between depths of 25 and 50 centimeters, often as a result of clay movement in percolating water and accumulation at this depth. Morphological examination, however, has established that no clay films coat the peds. This indicates that the clay movement has been minimal; the clay distribution is apparently a relict of the original distribution in the parent material. Most horizons of the Haplaquepts are more than 50 percent silt, the Fragiaquepts have horizons that are about 50 percent silt, and the Dystrochrepts have horizons that are about 25 to 50 percent silt.

Extractable calcuim. Figure 11 indicates that the Fragiaquepts are intermediate between the Haplaquepts and Dystrochrepts, but they are more nearly like the Haplaquepts below a depth of 50 centimeters in amounts of extractable calcium. The Dystrochrepts have less than 2 me/100g extractable calcium, and this decreases as depth increases. All soils have the highest nutrient level at the surface, as a result of additions of organic matter and the recycling of vegetation.

The extractable calcium is a measure of potential fertility that is dependent upon parent material, leaching processes, and vegetation. Low amounts of extractable calcium in the subsoil are accompanied by low amounts of other nutrients and high acidity. The Dystrochrepts particularly show this trend. The Fragiaquepts and Haplaquepts contain more magnesium and potassium because there has been less leaching, but amounts are not high. Dystrochrepts that have an Ap

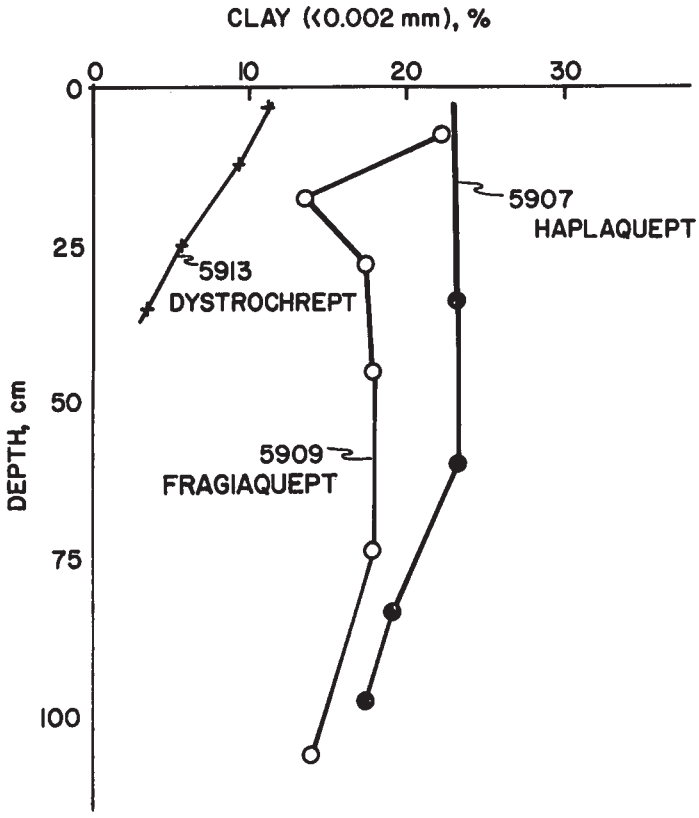

Figure 10.—Clay distribution by depth in a representative pedon of the Dystrochrept, Fragiaquept, and Haplaquept groups.

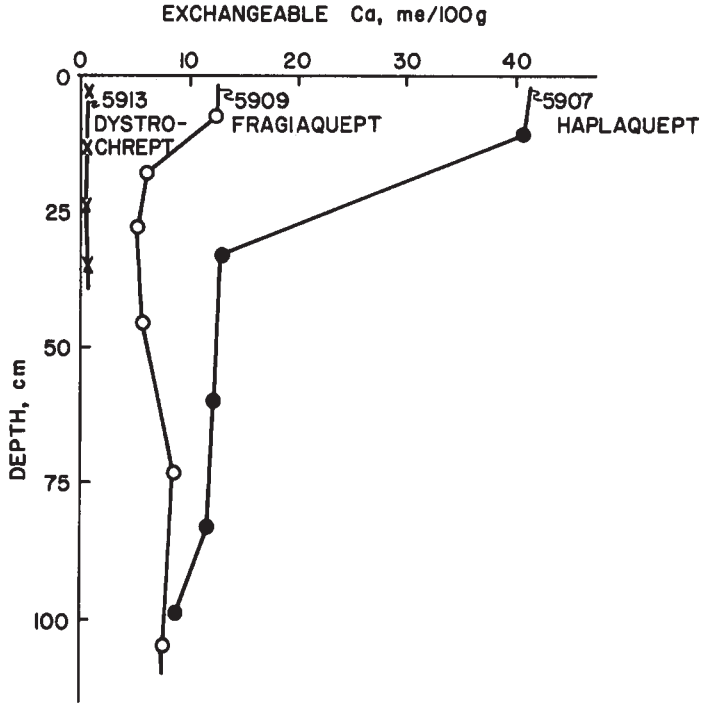

Figure 11.—Exchangeable calcium by depth in a representative pedon of the Dystrochrept, Fragiaquept, and Haplaquept groups.

horizon were still lower in calcium, magnesium, and potassium. Acidity is lower in the Fragiaquepts and Haplaquepts than in the Dystrochrepts. In the subsoil horizons, base saturation values for the Fragiaquepts and Haplaquepts were generally more than 35 percent and for some of the Fragiaquepts, more than 60 percent; whereas the Dystrochrepts were all less than 35 percent base saturated, and most were less than 20 percent. A slight increase in extractable calcium below a depth of 50 centimeters is noted in Fragiaquepts. This may be caused by the nonpermeable fragipan which prevents plant use of nutrients and intensive leaching.

The reaction also follows the trend of calcium. The subsoil horizons that are high in content of calcium, 10 me/100g, had a pH of more than 6.5; those low in calcium, less than 1 me/100g, had a pH of less than 5.5.

Percolation.—Percolation rate was near zero for the Haplaquepts and Fragiaquepts, and although the rate was moderate for the Dystrochrepts, their depth and content of fragments limit the installation of septic tank effluent drainage fields.

Clay mineralogy.—The clay mineralogy tends to reflect differences in parent material and in weathering. The dominant mineral in the clay fraction of all the soils is illite. Surface horizons show weathering of illite to vermiculite, which is present in minor amounts in all soils and generally decreases with depth as illite increases. Interstratified clay minerals also tend to decrease with depth in the profiles analyzed. With the above general composition, differences among Classification units are evident. The two Haplaquepts contained no other clay mineral than illite, vermiculite, and interstratified types. The other Haplaquepts contained significant amounts of montmorillonite, especially in the lower horizons, and a detectable amount of kaolinite. The clay fraction of the Fragiaquepts was 10 to 20 percent chlorite. The Dystrochrepts tended to contain more kaolinite clay than the other groups, particularly the Arnot and Lordstown pedons where maximum amounts of kaolinite reached 30 percent. Some chlorite was present in the Oquaga pedons, but little kaolinite.

Wetness in the Haplaquepts and Fragiaquepts favors the formation of montmorillonite. Parent material likely contributes to the amount of chlorite and kaolinite present, but illite was the dominant clay mineral of most parent material.

Coarse fragments.—Although some variation exists in Dystrochepts (fig. 12), the coarse fragments are more than 50 percent, by weight, of the total soil for the entire profile. At greater depths the amount is generally more than 60 percent. These pedons were all in the loamy-skeletal particle size family.

The two Fragiaquepts contained about the same percentage of coarse fragments as the Dystrochrepts in the fragipan at a depth of 35 centimeters, but to a depth of 25 centimeters, fragment content was much lower. These soils were cultivated, and some stones were removed and fragments deteriorated in the Ap horizon during cultivation. Also, the wetness above the fragipan probably hastened the physical and chemical breakdown of the fragments.

The Haplaquepts tend to have decidedly fewer fragments. but below a depth of 75 centimeters the amount

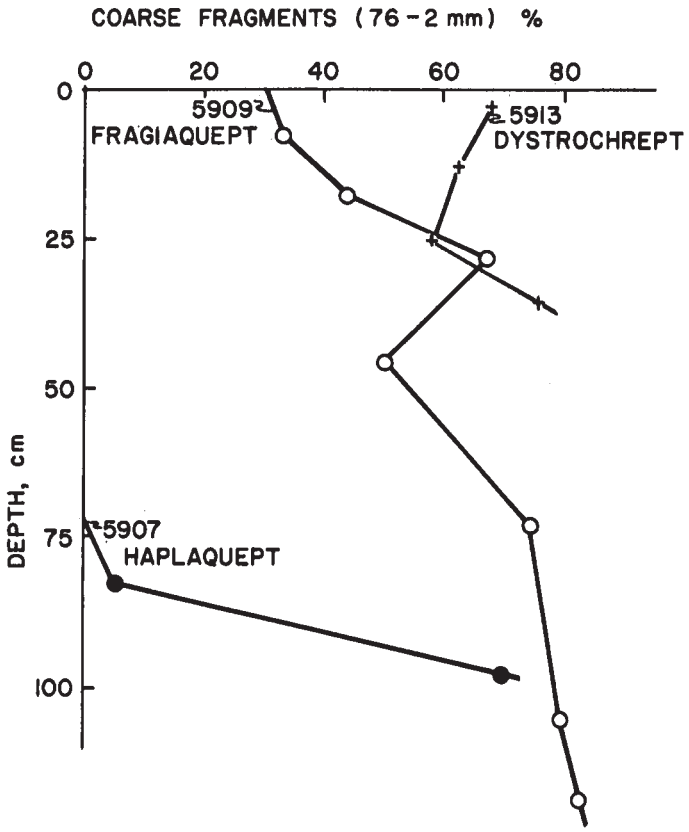

Figure 12.—Percentage of coarse fragments in a representative pedon of the Dystrochrept, Fragiaquept, and Haplaquept groups.

increases with depth. These soils are in areas that favor accumulation of moisture and also the accumulation of fine earth moving downslope from higher lying soils. They are very poorly drained and have few coarse fragments near the surface.

Environmental Factors Affecting Soil Use

This section provides information about some of the natural factors affecting use and management. It gives factors about the climate and geology as they relate to the county.

Climate

The climate of Tioga County is humid continental (*5*). Air masses originate mainly in the Central Plains of the United States or Canada. The Gulf of Mexico is the primary source of moisture, and the Great Lakes are a secondary source. Temperature and precipitation data are given in table 11.

Winters are generally cold and cloudy. Normal daytime temperatures average in the middle 30's, and nighttime lows drop into the mid-teens. Freezing and below freezing temperatures can be expected on about

TABLE 11.—*Temperature and precipitation data*

[Data recorded for the period 1931–1960 at Lawrenceville]

Month	Temperature				Precipitation			Snowfall		
	Average daily maximum	Average daily minimum	Highest	Lowest	Average	Days with 0.1 inch or more	Greatest amount in a day	Average	Maximum	Greatest amount in a day
	°F	°F	°F	°F	In	No.	In	In	In	In
January	36	17	70	−30	1.8	5	1.5	8.7	30.5	8.0
February	37	15	74	−34	1.8	5	1.5	10.7	27.0	14.0
March	45	23	85	−15	2.7	7	2.1	9.6	22.0	13.0
April	59	34	90	10	2.8	8	1.7	2.1	15.3	5.8
May	72	44	95	22	3.9	9	2.6	.1	4.0	2.0
June	80	52	100	29	3.3	8	1.7	0	0	0
July	84	57	107	39	4.0	8	3.4	0	0	0
August	82	55	100	34	4.0	7	4.8	0	0	0
September	75	49	100	23	3.2	7	2.1	0	0	0
October	65	38	91	12	2.8	6	3.6	.1	2.0	2.0
November	50	29	80	−8	2.4	6	1.8	3.8	12.0	12.0
December	38	19	68	−26	2.0	6	1.9	7.2	20.5	12.0

165 days a year, with subzero readings on about 11 days each winter. The record low temperature at Lawrenceville is −39° F.

The first snowfall of any consequence generally is reported in November. The normal seasonal total is about 42 inches. Snow cover of 1 inch or more occurs on about 37 days each winter, and 6 inches or more are reported on about 17 days.

Summers are generally pleasant. Daytime temperatures are in the 70's and low 80's, and nighttime readings in the 50's. Temperatures over 90° occur on about 18 days each summer. The record high was 107° at Lawrenceville. Summer rainfall is adequate for cultivation, and about 42 percent falls during the growing season. The rainfall comes mainly as showers and thunderstorms. Thunderstorms are reported on about eight days in spring, 22 days in summer, and six days in fall.

Some of these storms are occasionally accompanied by strong winds, hail, and lightning. No tornadoes have been reported in Tioga County since 1854.

Normal annual precipitation is about 35 inches at Lawrenceville. About 61 percent of the annual total falls from April to September. The record annual total ranges from a low of about 27 inches to a high of about 42 inches. Greatest monthly precipitation is about 11 inches, and monthly totals of less than 1 inch are reported occasionally.

Spring and fall are the transition seasons, and they have wide ranges in temperature. The growing season at Lawrenceville averages about 129 days. Growing seasons have been as short as 87 days and as long as 189 days. The average date of the last spring frost is May 23rd, and the average date of the first fall frost is September 29th.

Geology

Much of Tioga County is underlain by rock of Upper Devonian age. Rock of this age includes the Oswayo and Catskill Formations and marine beds, all of the Susquehanna Group. Marine beds are the most extensive and occupy the lower lying areas of the county from Wellsboro north to the Pennsylvania-New York line. They are thin-bedded gray and brown sandstone and siltstone and gray to olive brown shale. Soils that formed in glaciated areas underlain by these rocks are the Volusia, Mardin, and Lordstown soils that are dominant in association 2 of the General Soil Map.

The Catskill and Oswayo groups underlie the northwestern, central, and southern parts of the county. The Catskill Formation consists of thin-bedded red sandstone and red to brownish shale. The Oswayo Formation consists of brownish to greenish gray, fine and medium grained sandstone and some red shale. The dominant soils that formed in glaciated areas underlain by these rocks are Oquaga, Wellsboro, and Morris soils of associations 3 and 4.

Two mountain ranges traverse the county in a northeastern–southwestern direction. These mountains are underlain by red shale and brown to greenish gray flaggy sandstone of the Mauch Chunk Formation and the Pocono Group of Mississippian age. The highest locations are capped by the Pottsville Group of Pennsylvanian age. This group consists mainly of light gray to white, coarse grained, massive sandstone and conglomerate and some mineable coal. The dominant soils that formed in glaciated areas underlain by Mississippian and Pennsylvanian rocks are Lordstown and Mardin soils of association 1. The soils that formed in nonglaciated areas are the dominant Dekalb and Clymer soils and the less extensive Cookport soils in association 6 of the General Soil Map.

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Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushed easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low available water capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic-matter content and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium, and coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 milli-

meters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles) adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse" "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

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